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PROCEEDINGS

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GOVERNOR'S CONFERENCE ON THE FUTURE OF MARYLAND AGRICULTURE

Maryland With Pride

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Maryland Department of Agriculture and
The University of Maryland Agricultural Programs

In cooperation with
Maryland Department of the Environment
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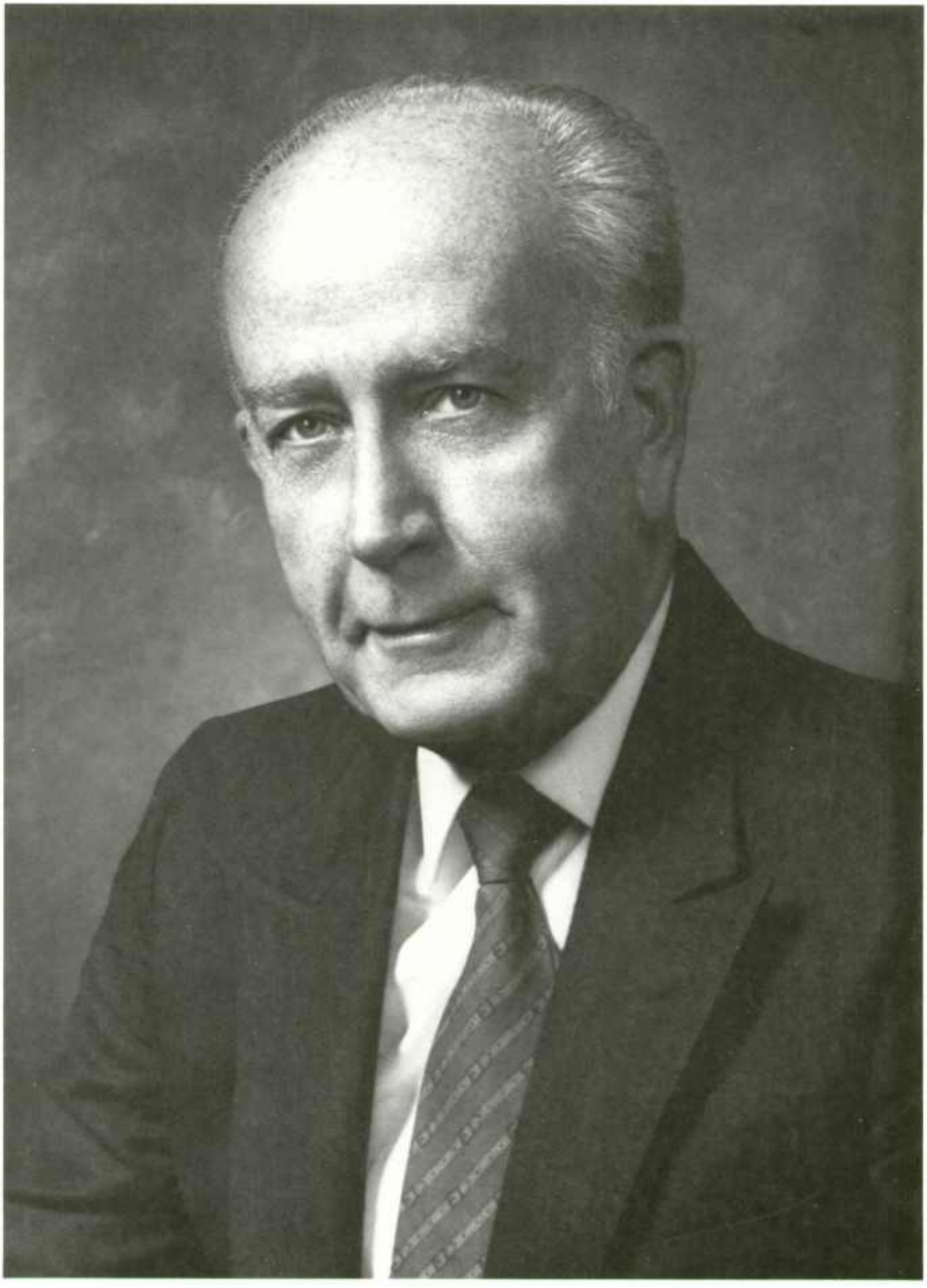

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May 1, 1989

Dear Friends of Agriculture:

On November 10 and 11, 1988, over 450 persons attended the first-ever Governor's Conference on the Future of Maryland Agriculture. The Conference dealt with three areas: the competitiveness of Maryland agriculture, agriculture and the environment, and agriculture and urban development. These areas will have a substantial impact on not only Maryland agriculture, but on the entire state in the next decade and beyond.

An important aspect of the conference was the development of recommendations based on both the information presented at the conference in ten major papers and the questions, comments, and suggestions of participants who attended the conference.

The conference and these proceedings are intended to be a starting point. I hope you will study the issues facing Maryland agriculture and initiate additional recommendations and actions to ensure a viable, prosperous agriculture in Maryland.

Sincerely,

William Donald Schaefer

Governor

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- The Maryland Department of Agriculture (MDA), the Maryland Department of State Planning and the University of Maryland Should Sponsor a Governor's Conference on Land Use.
- MDA Should Appoint an Advisory Committee on Agricultural Land Preservation.
- MDA Should Request That a Study Be Commissioned to Collect Data on Assessments and Taxes in Maryland and Selected Other States.
- MDA and the Maryland Department of Employment and Economic Development Should Appoint a Public-Private Council to Promote and Support Alternative Farm Enterprises.
- MDA Should Seek to Clarify Regulations Regarding Aquaculture.
- Maryland Should Increase Support for Basic Research, Field Demonstrations and Tests of New Agricultural Biotechnology.
- The Governor Should Establish an Advisory Council for Agriculture and the Environment.
- Maryland Should Issue Chesapeake Bay Bonds to Fund Best Management Practices.
- MDA, Maryland Agricultural Experiment Station (MAES), and Maryland Cooperative Extension Service (MCES) Should Conduct Research, Monitor, Predict and Evaluate the Effects of Federal Legislation and Farm Programs on the Agricultural Industry in Maryland.

The Maryland Department of Agriculture (MDA), the Maryland Department of State Planning and the University of Maryland Should Sponsor a Governor's Conference on Land Use.

Land use patterns are changing dramatically and unevenly in Maryland. Nearly all areas in the state will change substantially by the year 2010. In order to ensure the wise use of all land and the conservation and protection of natural resources, agriculturists as well as citizens must recognize and understand the changes that are taking place. The Governor's conference should alert the public about land use patterns; encourage affected parties to discuss the nature, causes, and impact of the changes; and devise recommendations and strategies to ensure the wise use of Maryland land. For longer run policies, MAES should give high priority to conducting basic and applied research on the effect of changing land use patterns on the viability of Maryland agriculture.

* The recommendations were drafted by Bernard Stanton, consultant; Henry Holloway, Wayne McGinnis, Donald Spickler, Alan Taylor and Edward Thompson Jr., co-chairs of conference workshops; and Arch Park and Earl Brown, co-chairs of the program committee. The recommendations were approved by the Executive Committee.

MDA Should Appoint an Advisory Committee on Agricultural Land Preservation.

Maryland's Agricultural Land Preservation Program is one of the best in the country and has been successful in preserving agricultural lands in some areas. However, there are two major problems. First, the appraisal process is flawed in terms of personnel training and procedure, and second, the prices offered are too low to attract sufficient farmland into the program, especially in densely populated areas.

Also, there should be better coordination among MDA, county governments and nonprofit organizations to facilitate "emergency" purchases of key farm parcels. The intent would be to make it possible for such units to preserve key agricultural lands that "anchor an agricultural valley; occupy an important place in a watershed; or comprise a particularly scenic view of the Bay."

MDA Should Request That a Study Be Commissioned to Collect Data on Assessments and Taxes in Maryland and Selected Other States.

The value of agricultural land in Maryland is affected by the demand for land for urban development. The relatively high cost of land and real estate taxes may place Maryland agriculture at a competitive disadvantage relative to other regions.

The study group should include agriculturists and representatives from the legislature, state agencies and county governments. The study should produce recommendations on tax reform and potential consequences for agriculture as well as state and local governments.

MDA and the Maryland Department of Employment and Economic Development Should Appoint a Public-Private Council to Promote and Support Alternative Farm Enterprises.

Maryland farmers, being located close to large population centers, have excellent opportunities to develop market niches for traditional and nontraditional farm products. Many farmers avoid new ventures because of the high risk of failure caused by legislative barriers, untrained labor, as well as inadequate venture capital, information and management skills.

Council members should represent government, industry, finance and agriculture and serve as a clearinghouse for capital, information and assistance by

- working with the state government, financial institutions and others to create a public-private fund from which farmers could obtain capital for new ventures;
- advising MAES and others about the kind of research that is needed to evaluate potential farm enterprises; and
- advising MCES, MDA, educational institutions and others about educational programs that provide the labor and management expertise needed for specific new farm ventures.

MDA Should Seek to Clarify Regulations Regarding Aquaculture.

MDA should continue to aggressively seek legislation that will place the regulation of aquaculture under its jurisdiction and clarify the regulations regarding aquacultural ventures. For example, clarification of regulations regarding fish and seafood raised on farms and fish and seafood raised in their natural environments is needed.

Maryland Should Increase Support for Basic Research, Field Demonstrations and Tests of New Agricultural Biotechnology.

MAES, MCES, and MDA have made substantial contributions over many years to improve and increase the adoption of agricultural technology. These activities should be continued, but in addition there should be increased support for basic and applied research to develop and test new biotechnologies and determine economic feasibility.

The Governor Should Establish an Advisory Council for Agriculture and the Environment.

Agriculture has a significant effect on the quality of the environment in Maryland. It is in the interest of all citizens that the positive contributions be enhanced and the negative effects be minimized without regulating farming to the point where agriculture is no longer competitive. This council, appointed by the Governor with the advice of the legislature, should work to find creative new approaches to ensuring successful agricultural production that contributes to a healthy environment.

The council should have five primary functions.

1. The council should provide a forum in which government agencies and interest groups concerned about agriculture and the environment can discuss both problems and opportunities related to the environmental impact of farming.
2. The council should advise executive and legislative branches of government on the economic and environmental effects of and alternatives to Federal, state and local government regulations.

3. The council should promote economical agricultural practices that optimize environmental quality and minimize environmental harm.
4. The council should help to ensure that the positive contributions of agriculture to environmental quality, such as clean air and open space, are not diminished by inappropriate growth patterns.
5. The council should encourage MAES, MCES and state agencies to give high priority to research and educational programs on environmental issues and to take the lead in promoting agricultural products that enhance environmental quality, such as the new biodegradable plastics. For example, state agencies could be encouraged to purchase items packaged in Maryland, farm-grown, biodegradable packages.

Maryland Should Issue Chesapeake Bay Bonds to Fund Best Management Practices.

Implementing best management practices on waterfront farmland is one of the most effective measures for improving the health of the Bay. Filter strips, grassed waterways and other permanent buffers reduce the movement of sediment and chemicals into the water. Because removing land from production and implementing these measures are costly practices, the costs should be borne by all who will benefit from the improvement.

Maryland should issue Chesapeake Bay Bonds as a traditional investment vehicle with a charitable twist. Purchasers would be encouraged to retire the bonds and donate the proceeds to the state and receive deductions against their income tax liability. The bonds could be zero coupon instruments maturing in the year 2034, the target date for an improved Bay and 400th anniversary of Maryland's founding. Bond denominations could range from $5 to $500,000 so every Marylander could participate. The proposed Advisory Council for Agriculture and the Environment could supervise the implementation of the bond program.

MDA, MAES and MCES Should Conduct Research, Monitor, Predict, and Evaluate the Effects of Federal Legislation and Farm Programs on the Agricultural Industry in Maryland.

Federal programs have different impacts on farming and local agricultural policies in different parts of the country. For example, Maryland farmers are subjected to pressures from urban encroachment and environmental constraints. It is therefore critical for Maryland's farmers, state government officials, and local communities to understand the implications of Federal policies that could place Maryland agriculture at a competitive disadvantage.

Executive Summary

Bernard Stanton

The first Governor's Conference on the Future of Maryland Agriculture was held in Baltimore, November 10-11, 1988. The stated objective was "to increase the level of interest, understanding and concern about the most important issues that will affect the future of agriculture in Maryland and to recommend alternative strategies and actions to address these issues." More than 450 farmers, agricultural leaders, representatives from agriculturally related businesses, state and local government officials, and individuals concerned with the environment and natural resource use attended the conference.

The vice chancellor for agricultural affairs of the University of Maryland was the keynote speaker providing an overview of the conference and the challenges facing Maryland agriculture. The balance of the first day's program was organized around three workshops: (1) the Competitiveness of Maryland Agriculture, (2) Agriculture, Natural Resources and the Environment, and (3) Agriculture, Land and Development. All participants had an opportunity to hear the principal points made by speakers in each workshop and both raised questions and made comments in response to issues raised. The evening banquet was addressed by Governor William Donald Schaefer who demonstrated his commitment and concern for the welfare of agriculture in the state.

The workshop chairpersons summarized the issues and recommendations growing out of their respective sessions at a general meeting of all participants, chaired by Lieutenant Governor Melvin A. Steinberg, on the second day. Major concerns about mechanisms to ensure the future competitiveness of Maryland agriculture, the ways in which agricultural production affects the environment, and the impact of development on agriculture and Maryland's land base were reviewed and discussed.

Ten major points were brought out in these discussions.

1. The cost of land, real estate taxes, and labor are likely to rise more rapidly in Maryland than in competing agricultural regions and may make it difficult for Maryland farmers to compete.
2. Biotechnological applications in agricultural production promise new ways to reduce the use of chemicals and pesticides in agricultural production, but require substantial additional research and testing before the applications can have important impacts on current problems.
3. Alternative enterprises and production strategies need continual study to ensure that producers can take advantage of their location close to markets and special windows of opportunity.
4. Adoption of new technology will lead to increased farm size, fewer commercial farmers, and greater specialization of production—further concentrating agriculture into the land areas best able to compete.
5. Environmental awareness and concern by the general public has increased much more rapidly than understanding or tolerance of what is scientifically accepted as environmentally sound agricultural practice.

6. Farmers believe they have been singled out unfairly as sources of environmental pollution in comparison with other major sources such as municipal sewerage facilities, industrial plants, land developers, recreationalists and homeowners.
7. The potential for conflicts between farmers and the nonfarm population over the use of air and water resources is growing rapidly particularly where these groups live in close proximity to each other.
8. The most important agricultural land in the state needs to be identified and protected from development pressures in some consistent manner.
9. An increase in housing density in rapidly urbanizing areas and a restriction of large lot zoning, except in identified agricultural areas, will slow the conversion of farmland and natural resources into development tracts.
10. The existing State Development Rights Purchase program needs review and greater publicity, and individual compensation for agricultural easements may not reflect their true values.

The Future of Agriculture in Maryland

According to Miller, agriculture, when defined as including the production, processing and distribution of food and fiber, is the largest industry in both the United States and Maryland in terms of employment and contribution to the gross national product. Miller cited economics, environmental quality, population and land use as the major determinants of future change in this key industry. Specifically, the primary factors are the viability of agriculturally related businesses, Maryland's ability to sustain its natural resource base of land and water, the rate of population growth in Maryland, and Maryland's commitment to use land intelligently so that agriculture is sustained, natural resources are protected, and standards of living are maintained.

After reviewing major trends and changes in Maryland agriculture, food consumption, employment, population growth and income, sources of environmental problems, and land use patterns, Miller suggested a set of actions needed to ensure a strong agricultural industry in the future.

1. The image of agriculture must be enhanced to include more than production and include the total food and fiber industry.
2. Society must understand that the food system is not risk free—food and fiber production will have some effect on the environment.
3. Agriculture is a high technology industry and Maryland must remain on the cutting edge if it is to compete.
4. Interest groups concerned with agriculture and the environment must learn how to work together toward common goals.
5. Nonagriculturists must recognize the importance of the markets being served, agriculturists must be more proactive in adopting the best practices and informing people of such actions, and both must try to be better neighbors.
6. An investment of time, energy and resources must be made to bring about necessary changes.

Vice Chancellor Miller concluded by challenging participants to move forward in improving the image of agriculture, participating actively in the planning process, seeking funds to carry out innovative research and action programs for this industry, and building coalitions to carry out the recommended actions growing out of this conference.

The Competitiveness of Maryland Agriculture

Since the 1950's Maryland's share of U.S. farm receipts has grown slightly, corn and soybeans are now more important than earlier, and high value vegetable crops have declined. In addition, increases in crop yields have followed national trends and broiler production has recently lost ground to other regions.

Gardner, in reviewing the competitiveness issue, cited the costs of land and agricultural labor as potentially the most difficult problems facing producers. Location relative to markets and the well-developed transportation network are positive factors. However, the added advantage of abundant water supplies is countered by the growing concerns about the impact of agriculture on water quality. The dairy industry, field crops and broiler production will continue to be important components of commercial agriculture in the near future.

According to Hueth and Kung, new agricultural technologies and applications of biotechnology promise continued increases in agricultural productivity in the coming decades. The promise of enhanced product quality and reduced dependence on agricultural chemicals and pesticides are particularly appealing. Emerging technologies and the time horizons for potential adoption were reviewed. Nearly all are seen as requiring more sophisticated management, and will continue to lead to larger, more specialized farming units. Maryland was suggested to be a state that would benefit more than most from developments in plant biotechnologies. A strong commitment to research in this area was encour-

aged through the proposed Maryland Center for Agricultural Biotechnology.

Interest in alternative enterprises to replace some of the more traditional agricultural enterprises in Maryland has been growing. Strand and Lipton examined aquaculture as one possibility, more specifically pond production of hybrid striped bass. They considered demand and market outlets, production costs and capital requirements, technical production requirements, and potential competition with other producing regions in their analysis. The methods used and questions posed are quite appropriate in analyzing other alternatives.

Agriculture, Natural Resources and the Environment

Productivity in agriculture is dependent on practices that seek to maximize yields and minimize costs. In the process these practices affect soil and water resources, sometimes adversely according to Tassone and Weismiller. The impacts of sediment, fertilizer nutrients and pesticides on surface and ground water resources were examined carefully. The average soil loss from cropland in Maryland is 5.2 tons per acre per year. This rate can be reduced with better management practices. Nitrogen and phosphorus losses in surface water can be further reduced. Ground water contamination from nitrates and pesticides is increasingly recognized as a long-term problem. Better monitoring of ground water resources and increased use of Integrated Pest Management is recommended.

Magette and Brodie discussed potential conflicts from the use of air and water by agriculture. States and local governments have primary jurisdiction. As more and more of the population live closer and closer to a decreasing number of farmers, the potential for conflict grows. Agriculture uses less than 1 percent of the state's water but may be the primary user in the part of a county where irrigation of intensive crops is important. The Water Appropriation Law is suggested as an effective tool with which to avoid conflicts for water.

Air quality degradation by agricultural activities is not currently regulated. Odor problems associated with livestock production may intensify as production becomes more concentrated. Local governments may be able to minimize conflicts by identifying agricultural production areas in their land use planning and zoning activities.

Maryland has a limited acreage of prime farmland. Berg, in his paper on land use management and policy asked if a sustainable, prosperous agriculture is a long-term goal of the state. If the answer is "yes," then he argues that soil erosion must be controlled; agriculturists should join environmentalists in seeking that end. State and Federal cooperation should be encouraged. Cost sharing with Best Management Practices on private lands deserves priority to achieve nonpoint pollution control. Because 95 percent of the land in Maryland drains into the Chesapeake Bay, this issue is everyone's concern. Targeting soil conservation efforts to lands most affecting the Bay is one approach.

Agriculture, Land and Development

Competition between agricultural and urban uses of Maryland's supply of rural lands cannot be resolved by market forces alone. Prime farmland is often prime development land. Rapid growth is posing stiff competition for Maryland's farmland, permanently removing some 4,000 acres a year from production. Moreover, English claims the pattern of this growth—dispersed, low density residential development, in particular—threatens the critical mass of farmland needed in each of Maryland's agricultural regions. Thus, claimed Hutchinson, protection of agricultural land must rely on society to intercede through land use controls. Ultimately, successful farmland protection programs depend on a healthy economic base for farming.

Advocates of farmland protection must recognize the need for viable sized farm units and the need to stabilize and improve environmental quality. Hutchinson thus suggests a "prime farms" approach instead of "prime farmland".

Land developers are willing to pay roughly 10 percent of the value of the finished dwelling unit for raw land; finished lots are in the 25 to 30 percent range. It is difficult for traditional agriculturists to compete with these prices. Land use controls should seek to decrease lot size in areas designated for development and increase lot size to 20 to 50 acres in areas where farmland is protected. Agricultural zoning is another possibility, but land use regulation alone will not protect farmland. Farming must be economically viable and environmentally sound.

The farmer's right-to-farm protections also should be increased to ameliorate conflicts with urban developers. Thompson and McGinnis, co-chairs of the Agriculture, Land and Development Workshop believe the state farmland preservation program should be modified to provide a more timely, competitive level of compensation to landowners. McGinnis also believes regulations on agriculture and property tax assessments should be reviewed to eliminate unnecessary burdens that make it harder for farmers to remain on the land.

English argued that Maryland's growth pattern is unnecessarily threatening the land resources required to sustain viable agricultural and forest industries. In addition, dispersed, large-lot development is threatening the state's open space, natural areas and environmental

health. English pointed out that agricultural land is being lost at unprecedented rates, and low density development is fragmenting the critical land mass needed to sustain agriculture and forestry. He stressed the need for improved land use planning, the redirection of growth into existing urban areas, and coordination of programs for conservation and growth management.

An examination of different ways in which economic development can proceed at the local level was presented by Falk and Finsterbusch. Maryland was depicted as both northern and southern; rural and urban; developed and undeveloped. The range of differences from county to county was recognized, and the community needs and resources were substantially different. Development strategies must therefore fit community interests and economic resources. Illustrations of different approaches were drawn from experiences in the Delmarva peninsula.

It can be stated with a high degree of certainty that the issues addressed in this conference will have a significant impact on the future of agriculture in Maryland. Some issues will not be addressed satisfactorily because of high costs or the inability of conflicting groups to reach agreement. Some issues will be resolved easily, while others will require the investment of considerable time, effort and funds.

Keynote Address The Future of Agriculture in Maryland

Raymond J. Miller

Agriculture—the production, processing and distribution of food and fiber—is not only the largest industry in the United States, it also is the most important. It is America's largest industry because it provides employment for about 20 percent of the U.S. work force. Agriculture is America's most important industry because it lies at the root of the hierarchy of basic human needs—all people must eat to sustain themselves and everyone needs clothing and shelter. Fiber (timber, wool, cotton and linen) accounts for the largest percentage of materials used to make clothing and shelter.

Agriculture also is the largest industry in Maryland, accounting for approximately 14 percent of the state's gross product. Because of the economic importance of agriculture and its relationship to the use of natural resources, it is imperative that issues related to the future of agriculture in this state be examined.

Participants at the Wye Conference on the Future of Agriculture and Natural Resources in Maryland, held in August 1987, agreed that this Governor's Conference was needed. Many issues that affect the future of agriculture were discussed at the Wye Conference and those discussions and ideas should carry over to the agenda for this conference.

Those who have gathered here today—producers, citizens, natural resource users, agency personnel, researchers, educators and policymakers—know that Maryland agriculture is changing dramatically. What are some of the factors involved in Maryland's changing agriculture, and what short- and long-term agendas should be worked on to ensure its continued viability?

There are four primary factors that have an impact on agriculture and natural resources. All four of these factors have an impact on agriculture individually, all interact with one another, and all change in dramatic ways.

1. Economics—the ability of agricultural businesses to be economically viable.
2. Environmental quality—sustaining the natural resource bases of land and water.
3. Population—population growth in Maryland.
4. Land use—the intelligent use of land so that agriculture is sustained, natural resources are conserved, and the current standard of living is maintained or enhanced.

A brief review of the trends in each of these areas follows. Suggested short- and long-term actions that the agricultural community needs to take, as well as possible outcomes of this conference also will be addressed.

Areas That Affect Agriculture

Economics

Technology, markets, weather, production levels and production efficiency are among the factors affecting the economics of agriculture. One of the most important factors in American agriculture has been the increasing sophistication of agricultural technology. Agriculture is a high-tech industry. Producers cannot control the weather or international markets, but they can make

choices about a key variable—the technology they use. Look for a moment at how well Maryland production agriculture has done compared to the nation by looking at long-term yields. This will indicate the degree of technology development, adaptation and use.

The following graphs show long-term trends for Maryland and the United States. By looking at yield per acre or production per animal, it can be seen whether or not technology utilization has increased so that more per unit is being produced and how. It can be seen how Maryland's trends compare with the United States.

- U.S. wheat yields are increasing and Maryland's yield is somewhat higher than national yields (Figure 1).
- Both Maryland and U.S. corn yields are increasing, suggesting both the development and use of new technology (Figure 2).
- Maryland and U.S. soybean average yields are similar. Soybean production has not changed significantly for some time (Figure 3). What has to be done to increase yields substantially? Will biotechnology provide the answer?
- For the most part Maryland has maintained the edge over U.S. barley yields since 1964 (Figure 4). The gap, however, has narrowed significantly, and yields are again increasing.
- Hay yields nationally and in Maryland have become similar in the last few years (Figure 5).
- Milk production is one of the best examples of the impact of development and application of technology. Pounds per cow have gone up continuously as the genetics, nutrition and management of herds have improved (Figure 6). Maryland and U.S. trends are the same in this area.
- Poultry production has increased significantly in Maryland for some time (Figure 7). However, problems exist and it will take sustained cooperation and technology development to remain competitive.

From these figures it is evident that, in most cases, Maryland yields are comparable to national yields. In some areas, however, Maryland producers are not using the technology needed to increase efficiency and therefore to meet increased costs. This is a critical point—especially since prices are at the same level now as they

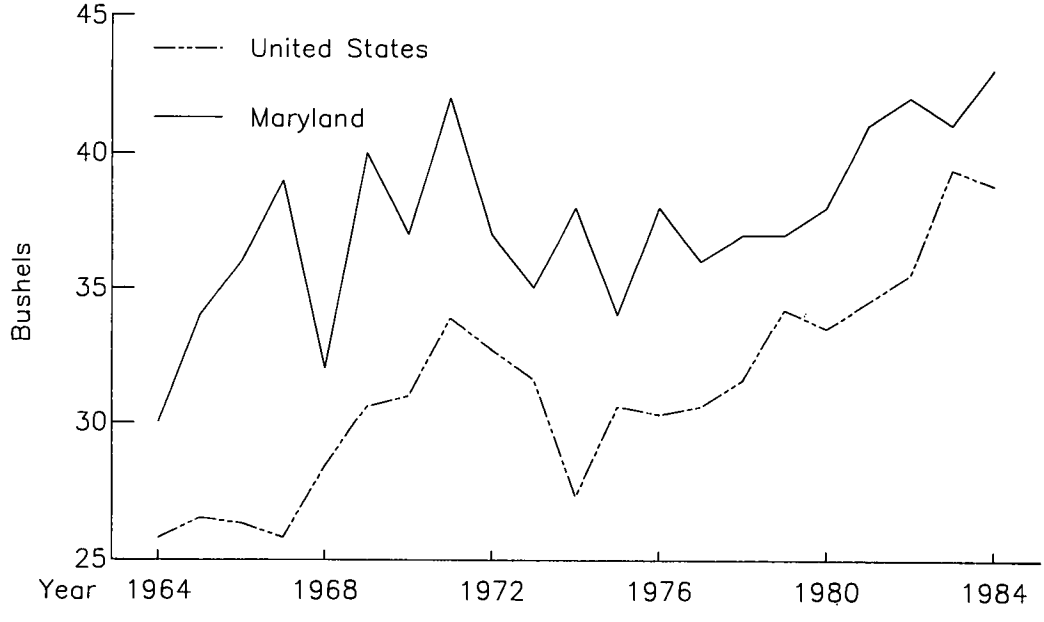

Figure 1. Wheat yield per acre.

Agricultural Statistics 1985, USDA Washington DC 1985

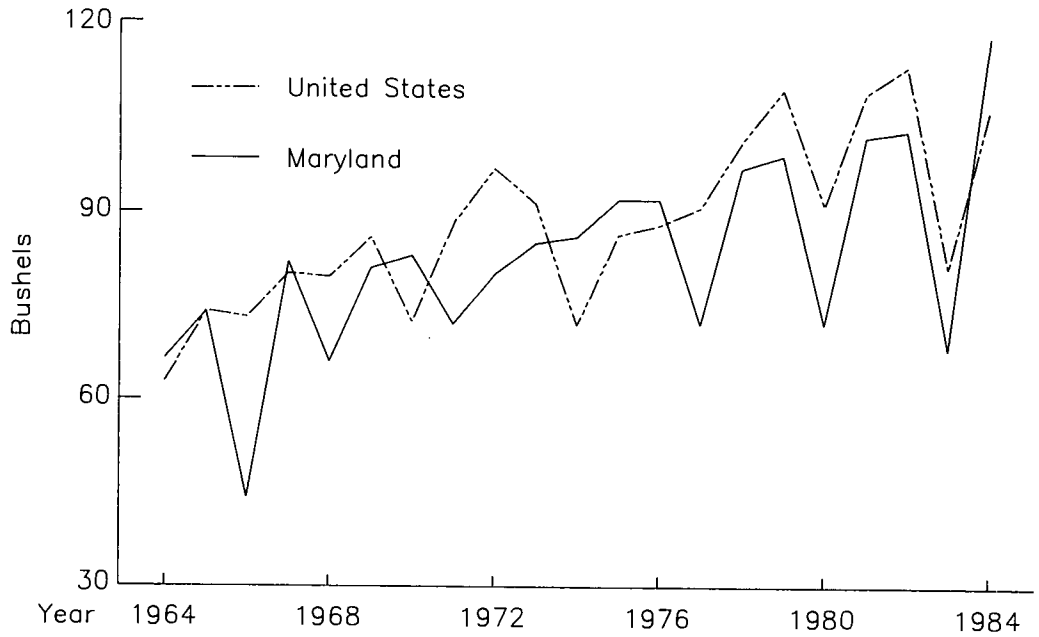

Figure 2. Corn (for grain) yield per acre.

Agricultural Statistics 1985, USDA Washingtan DC 1985

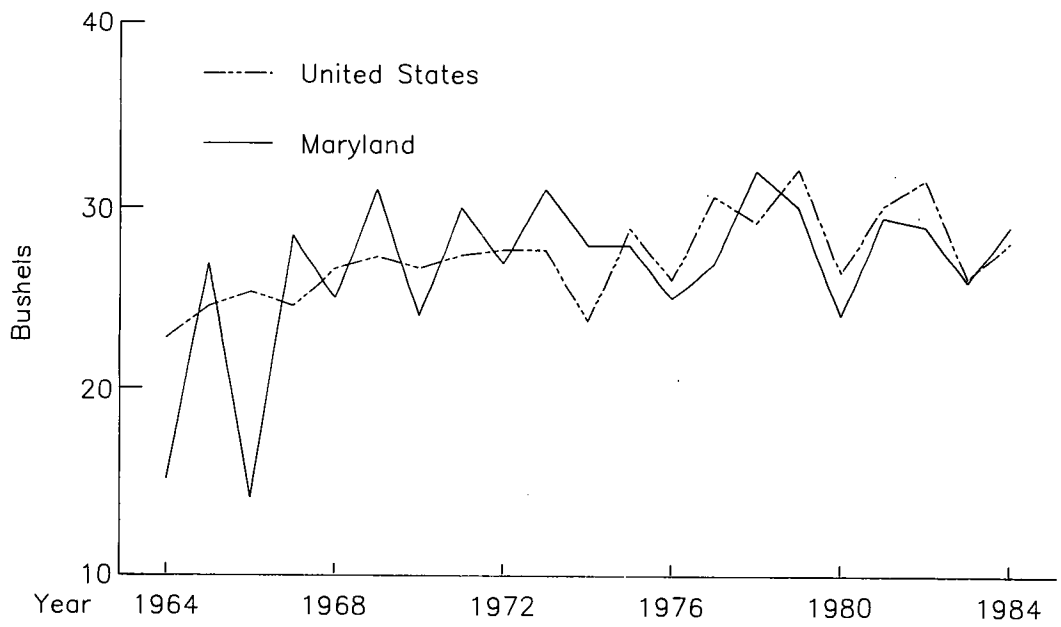

Figure 3. Soybean yield per acre.

Official Estimates, Agricultural Statistics Service USDA, Annapalis, MD, 1986

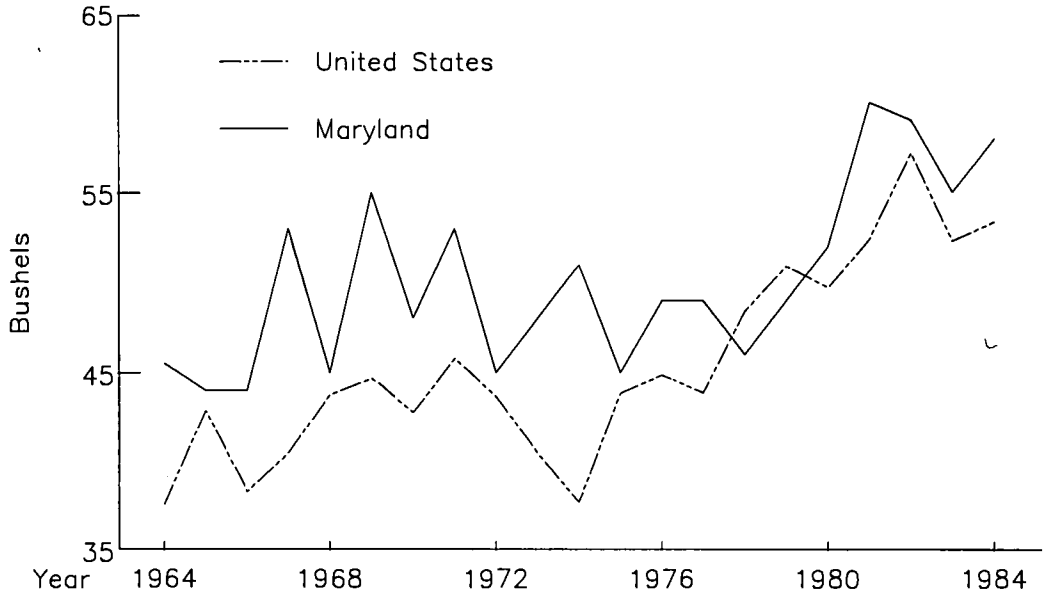

Figure 4. Barley yield per acre.

Official Estimates, Agricultural Statistics Service USDA, Annapalis MD 1986

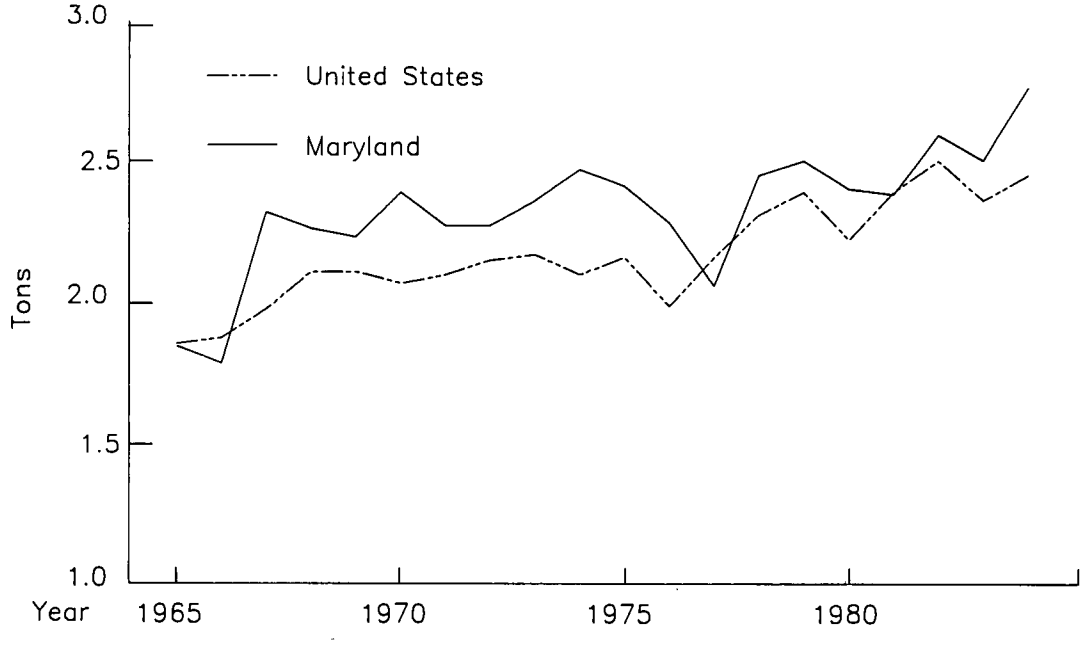

Figure 5. Hay yield per acre.

Official Estimates, Agricultural Statistics Service USDA, Annapalis, MD 1986

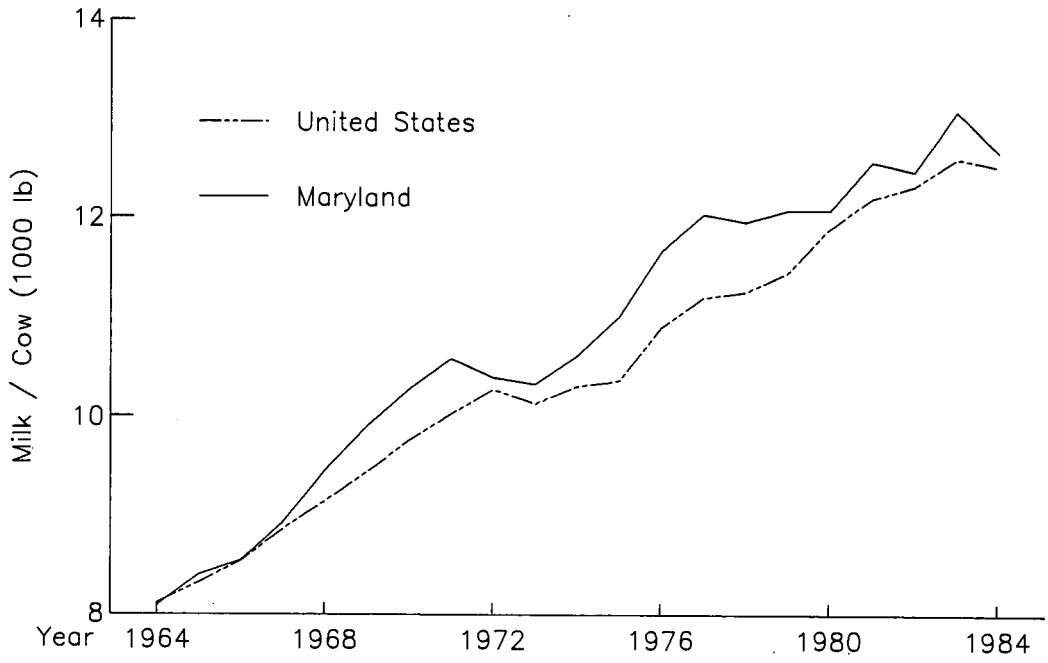

Figure 6. Milk production in the U.S. and Maryland.

Official Estimates, Agricultural Statistics Service USDA, Annapolis, MD 1986

were years ago, and international competition is increasing. If Maryland is to have a viable agriculture, the state must be involved in the development and use of technology. If not, other countries and states will be the first to benefit.

On the other hand, it is important to note that Maryland has had major growth in nontraditional agricultural areas—particularly the nursery and turfgrass industries. The aquaculture industry also holds promise in Maryland. What then is the market potential of nontraditional crops and aquaculture? What other alternative areas should Maryland's producers be pursuing?

Other factors also are affecting the economics of agriculture. Individual spending patterns have changed significantly between 1947 and 1985 (Table 1). Because of continuing developments in agriculture during those years, Americans spent a great deal less on food and more on housing and medical care than in previous years. Employment trends in the food system also have changed drastically (Figure 8). For example, in comparing years 1950 and 1982, farming decreased by over 50 percent, and the food service sector increased significantly.

Changes of this type have led to a poor understanding of the contemporary food system, and to little societal support for it. Paradoxically, one might say that the success or the modern miracle of agriculture has led to a lack of appreciation of the agricultural system. Re-education is needed.

Environmental Quality

Approximately two decades ago, Americans became concerned about conserving their natural resources. Groups began to express concern about such issues as the amount and kinds of chemicals being added to the environment, the erosion of soils, and the population and diversity of wildlife species. Today, concern continues about these issues, as well as the quality and quantity of water. Water quality is undoubtedly an issue that will dominate agendas in the next decade and beyond.

Use of pest-control chemicals, the Chesapeake Bay, and ground water quality are the primary water quality issues in Maryland. The use of insecticides is now decreasing in the United States (Figure 9). Total usage has been reduced in recent years because of the development of new chemicals, as well as the implementation of integrated pest management (IPM) programs. Although most people think of agriculture as the main culprit in terms of pesticide usage, in a heavily populated state like Maryland, the suburban homeowner is using about as many chemicals per acre as an agricultural producer, but is not licensed and is less aware of the impact of such chemicals.

The second water quality issue involves the Chesapeake Bay. The Chesapeake Bay agreement calls for a 40 percent reduction in nutrient loading by the year 2000. The contributions of nitrogen and phosphorus to

Table 1. Allocation of U.S. personal consumption expenditures

Expenditure Category	Percentages Per Year					
	1947	1954	1963	1972	1982	1985
Food and beverages	32.1	27.9	23.6	21.0	19.5	18.0
Housing services[1]	9.9	13.3	15.2	14.8	15.7	15.5
Medical care	3.7	4.2	5.5	7.7	10.6	11.2

[1] Rents and the imputed rental value of owner-occupied housing.
Source: Connor 1988.

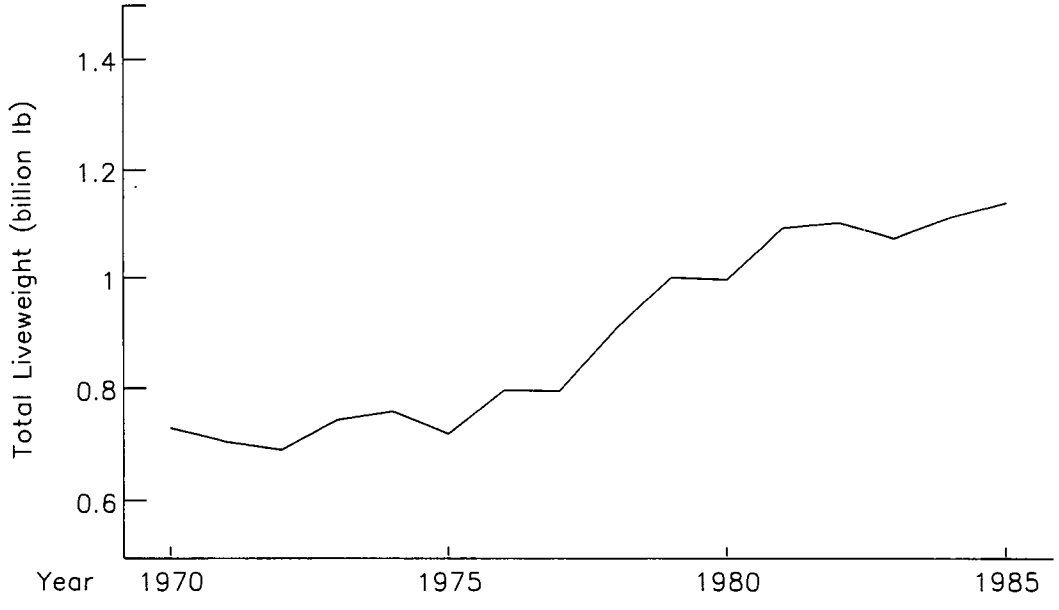

Figure 7 Maryland poultry production, broilers.

Official Estimates, Agricultural Statistics Service USDA, Annapolis, MD 1986

that loading are shown in Figure 10. These data represent the magnitude of chemical contributions to surface water quality in Maryland. Agriculture represents a significant factor.

Yet another important water quality issue in Maryland is ground water. The exact quality of ground water is not known, but studies are being initiated. The potential areas of ground water contamination in the United States, resulting from pesticide usage, are shown in Figure 11. Much of Maryland's ground water has a high potential for pesticide contamination and a lesser potential for contamination by nitrogen.

In terms of sources of water, about one-half of the state obtains water from ground water and the other half from surface water. In general, residents of Southern Maryland and the Eastern Shore obtain the bulk of their water from ground water. The rest of Maryland uses water from surface sources. Citizens must be concerned about their water and aware of the factors that may be contributing to its deterioration.

Population

One of the major factors driving change in Maryland is its population (Figure 12). Between 1950 and 1970 Maryland experienced an average overall growth of 2.4 percent. During the 1980's the growth rate was 0.7 percent. Projections forecast that this latter rate of growth will continue through the year 2000. As you know, that population has become increasingly urbanized. In the past 30 years, there has been a significant shift in land-use patterns from cropland and pasture to residential areas.

Land Use

Land use for farms has followed an inverse trend to that of population in the last 35 years. In other words, where the general population has grown, land used in farming has decreased (Figure 13).

The percentage change of land use between 1950 and 1976 is shown in Table 2. Land used for both

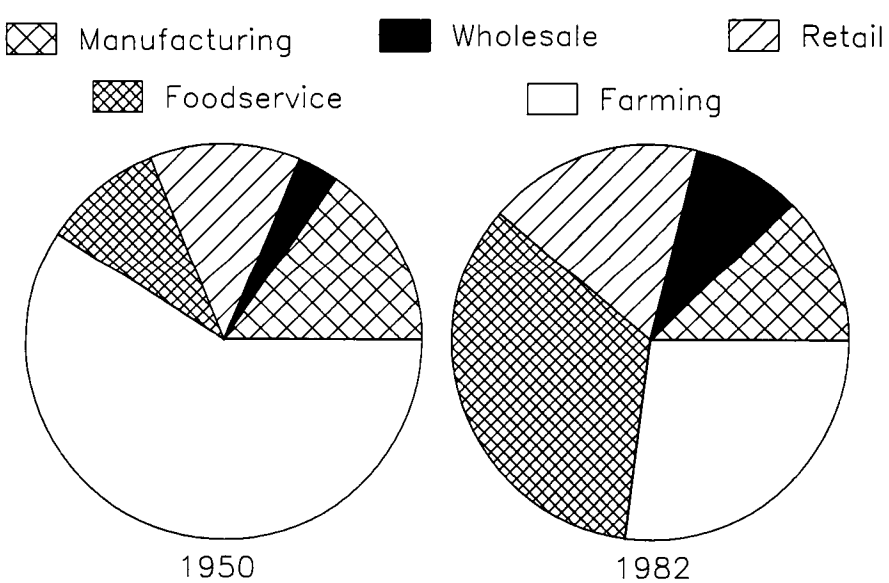

Figure 8. Employment trends in the U. S. food system, 1950 – 1982.

Connor 1988

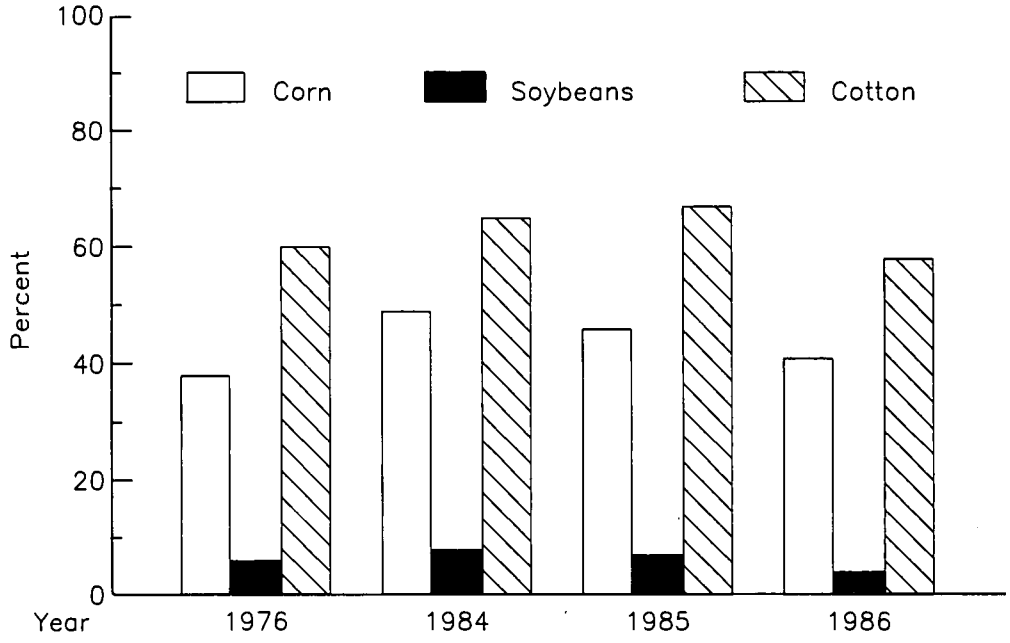

Figure 9. U. S. crop acres treated with insecticides.

USDA Chartbook 1987

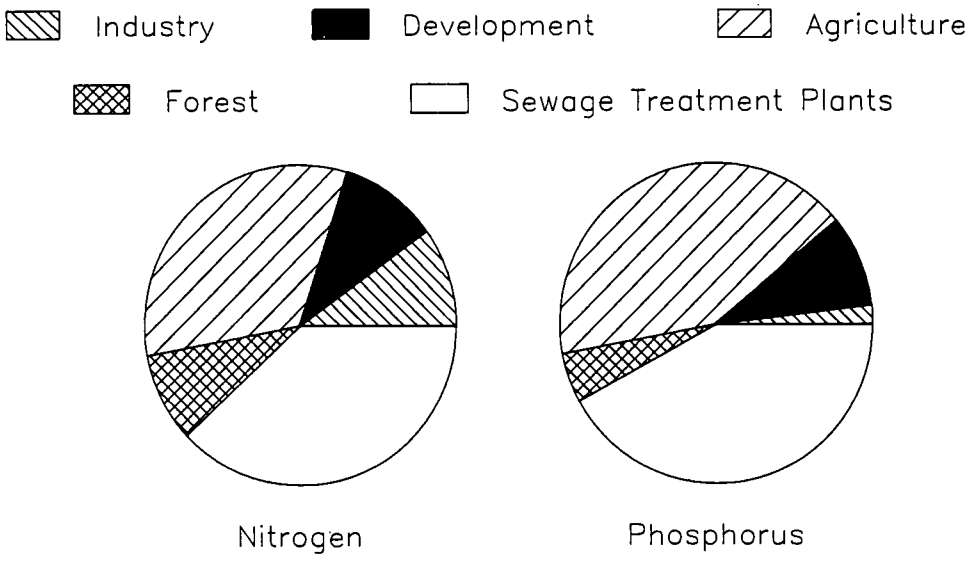

Figure 10. Maryland's nutrient loads into the Chesapeake Bay, 1985.

Maryland Department of Natural Resources and Water Resources Administration

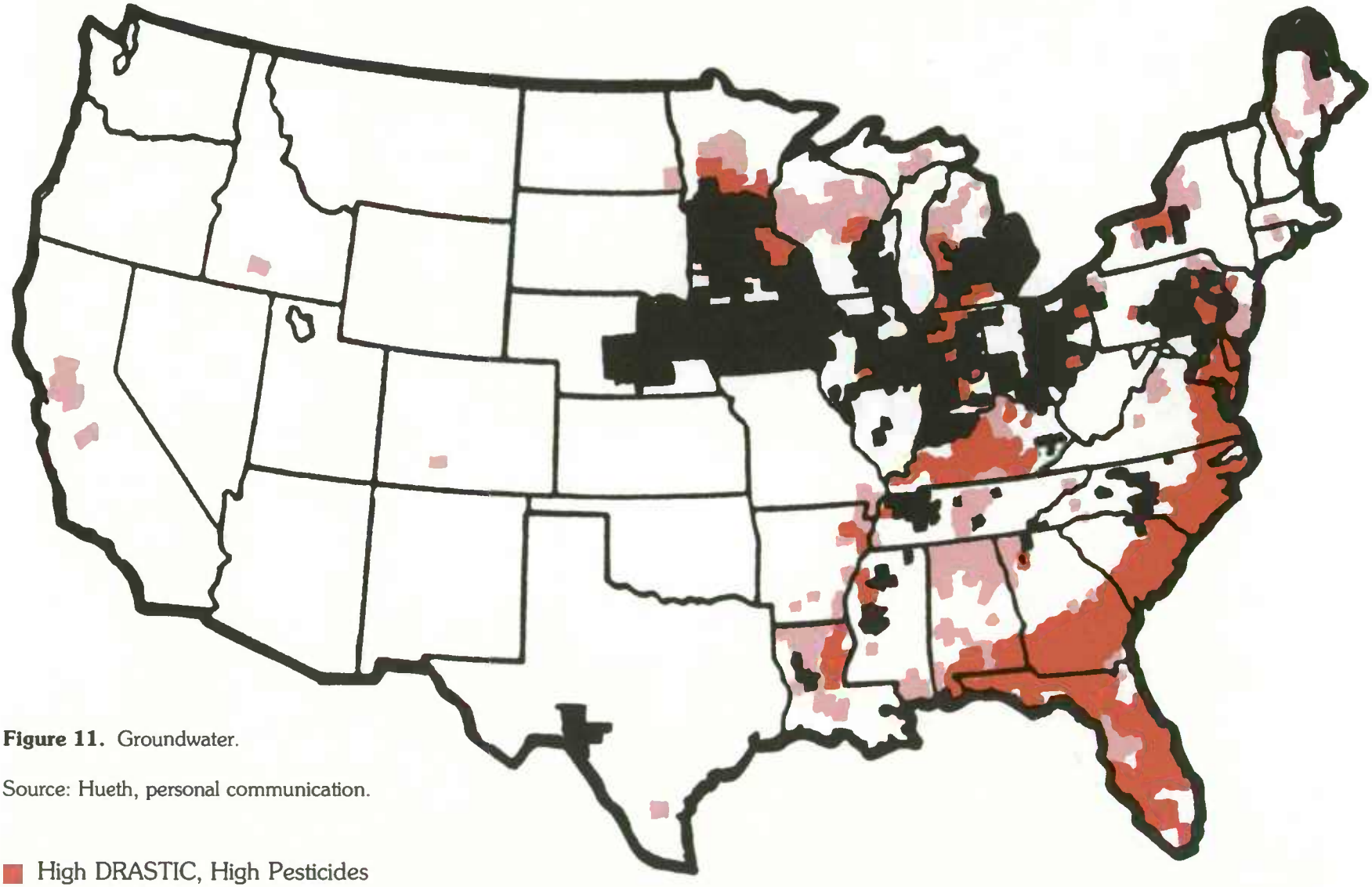

Figure 11. Groundwater.

Source: Hueth, personal communication.

Table 2. Percentage land use, 1950 and 1976

Use	1950	1976
Agriculture (including woodland)	48	35
Forest	46	42
Other	6	23

Source: Maryland Department of State Planning, 1983.

farming and forestry has decreased, with "other" uses increasing substantially. Alternate uses of lands are now approaching the amount used for farming. This shift and some of its implications have not been fully recognized. For example, the use of pest control chemicals used in nonfarming areas is approaching that used in farming areas.

The changes in land use between 1985 and those projected for the year 2000 are illustrated in Figures 14 and 15. With all of these changes come many questions. What does society have to do in order to simultaneously have a sustainable wildlife, a sustainable natural resource base, and a sustainable agriculture? Does Maryland's agriculture have a future? Yes, but there are a number of things that its citizens have to do.

Steps to Ensure Maryland's Agricultural Future

Understanding the basic characteristics of agriculture and being willing to change to profitable practices are the essential steps for ensuring the future of agriculture in Maryland. Agriculture is much more than production. Individuals must learn to associate the total food and fiber system with agricultural production. Producers and educators can help by talking more to others about this issue, not only to themselves. In this manner the image of agriculture will be enhanced.

Other characteristics of agriculture involve risk and technology. Americans must understand that, like life, the food system is not risk free. People cannot produce, process and distribute food and fiber without having an impact on their environment. Maryland citizens must recognize the cost of increasing yields on the farm.

Agriculture is a high-technology industry and it will continue to be. Maryland must be at the cutting edge of relevant technology development so that the state may capture the financial benefit of being among the first to adopt the technologies essential for improving production.

Today's society is made up of many different interest groups. These groups must learn to communicate with each other, realize that in many cases they have common goals, and work together. The cooperation among and between groups will facilitate whatever changes are needed to maintain a productive agricultural system.

To prepare for the future, agricultural groups may have to change their point of view. Producers, for example, must recognize that the way they are doing things may not be optimal and be willing to change current practices and products. Producers must assume more of a marketing orientation if they wish to increase sales. The products they produce and deliver must be tailored to the market. (This may be a new market niche—a response to changing population patterns or changing desires—or it may be a new foreign market.)

"Agriculture is much more than production. Individuals must learn to associate the total food and fiber system with agricultural production."

To change their point of view, producers must be proactive. They must take the lead in making these changes by developing and adapting the best practices or products and then informing people. A good example of this is integrated pest management (IPM). How many people know that IPM was developed by agriculturists to increase efficiency and reduce pesticide use and that it now is being increasingly applied in urban settings? Finally, producers must recognize that a good neighbor policy will be critical in the years to come. They must be good neighbors to individuals in both production and nonproduction enterprises. This will take patience and compromise.

Other groups involved in the agricultural system will have to make changes as well. Specifically, they must all be willing to invest the time, energy and resources to help bring about a better and more appreciated agricultural system.

Possible Conference Results

This is a very important conference and concrete outcomes are expected. Participants will identify key issues that affect the future of Maryland agriculture and make some recommendations. The Governor is looking for both a short- and a long-term action agenda. For example, in what types of long-term research and technology development should researchers be engaged to prepare effectively for the future?

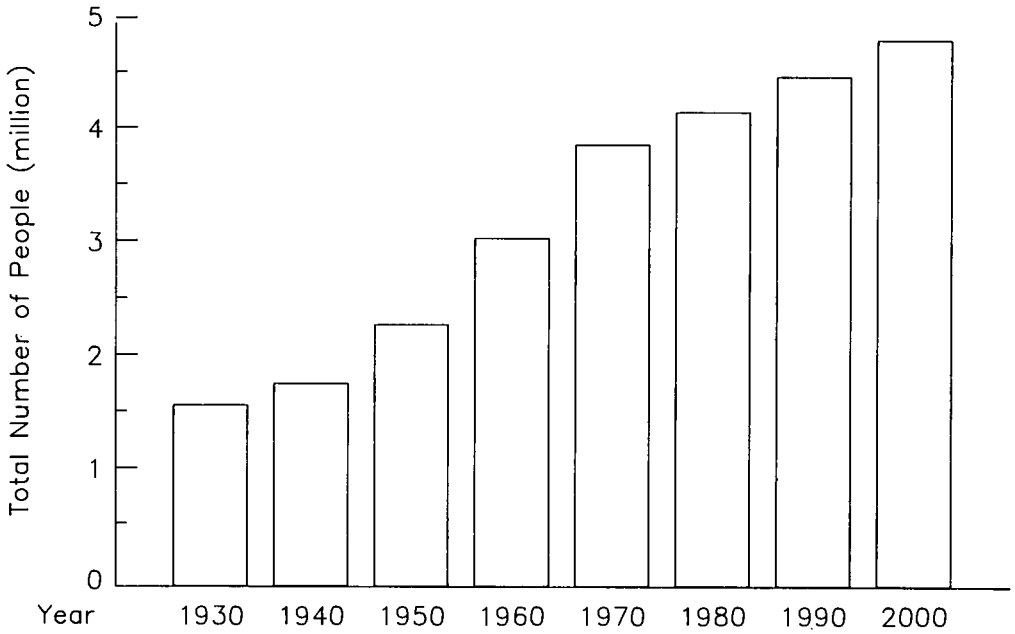

Figure 12. Population growth in Maryland, 1930 – 2000.

MD Chartbaak and Dept. State Planning

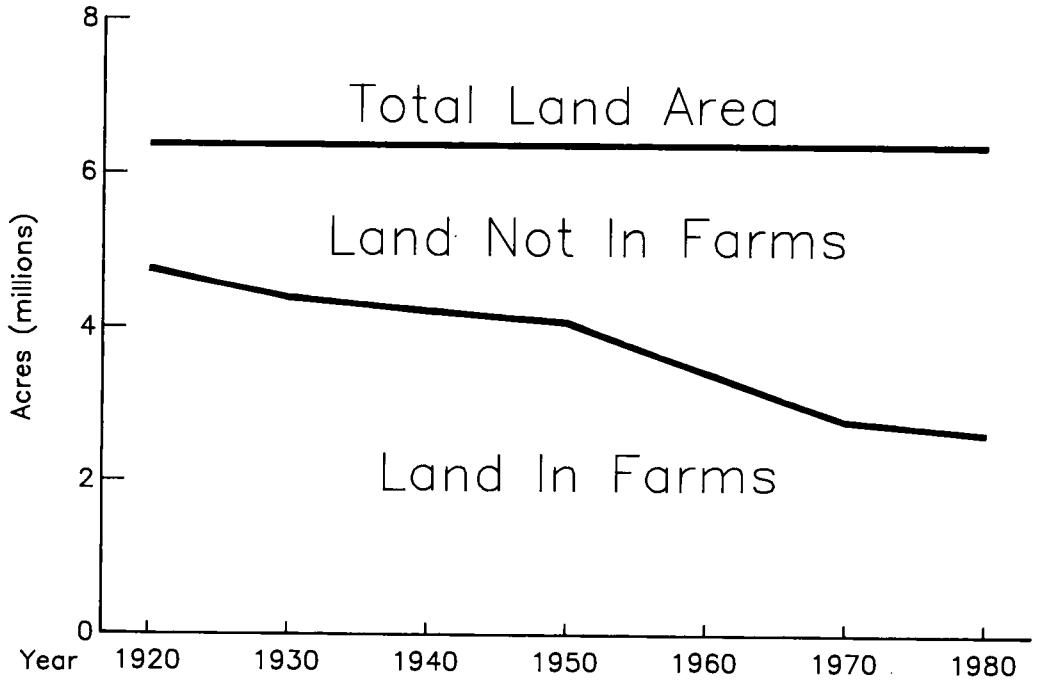

Figure 13. Land use in Maryland.

Mundy et al. 1985

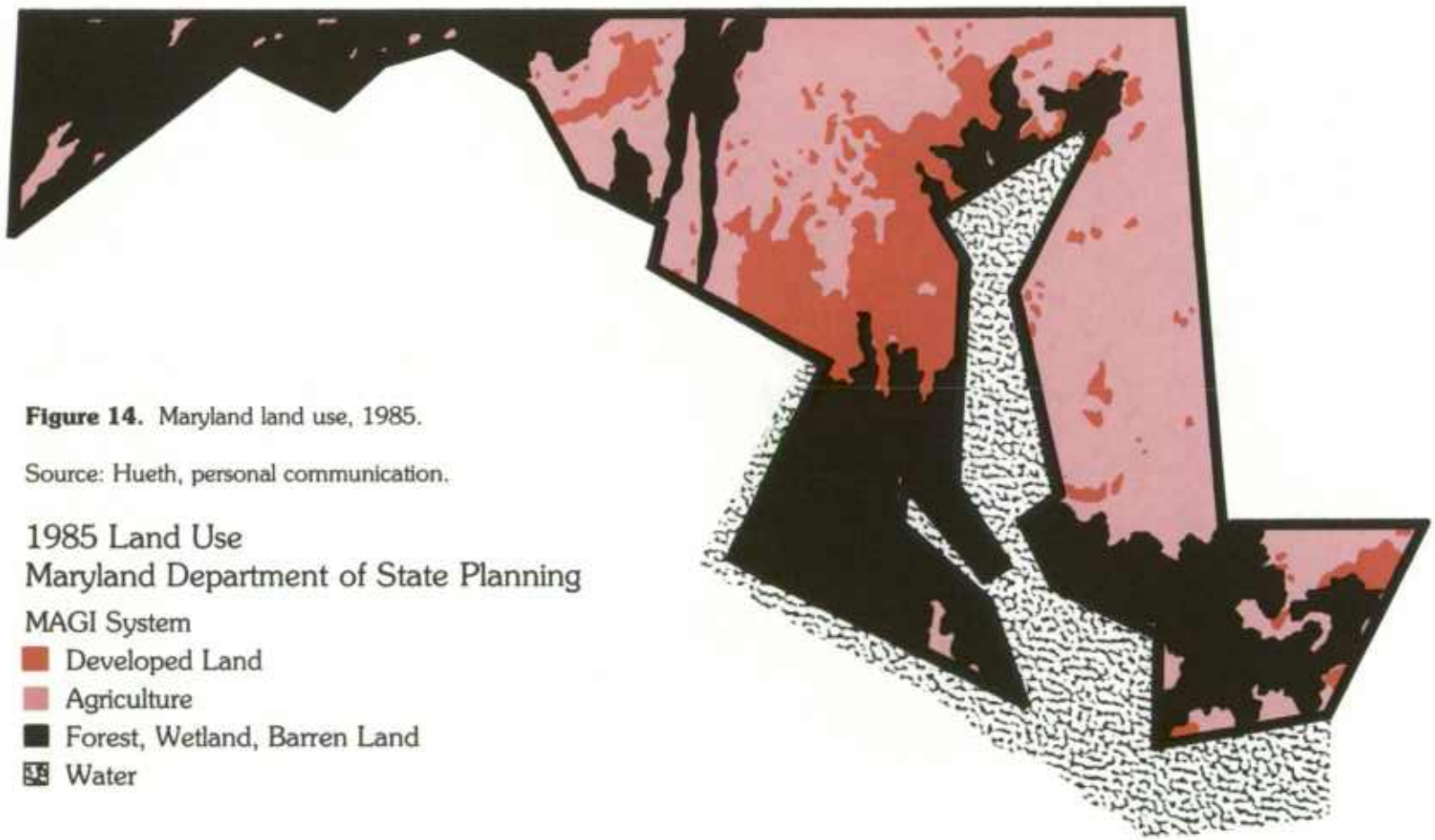

Figure 14. Maryland land use, 1985.

Source: Hueth, personal communication.

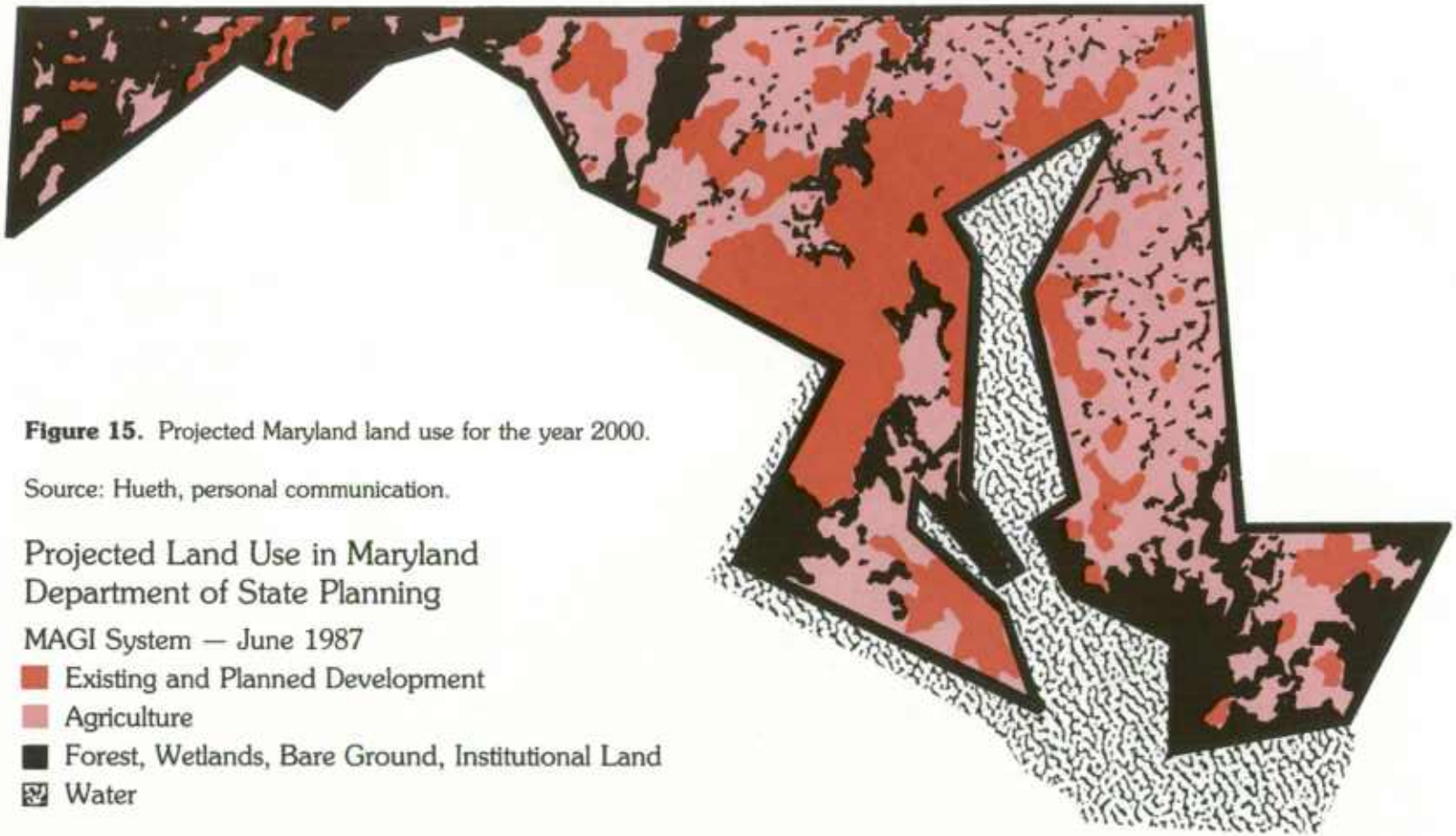

Figure 15. Projected Maryland land use for the year 2000.

Source: Hueth, personal communication.

What will be the actual results of this conference? That is up to you. Possible outcomes from this conference follow.

- Action groups formation. The image of agriculture is a problem. Perhaps action groups could be formed by counties or communities, and key people who need to expand their knowledge about the food and fiber system could be identified. Key decisionmakers could be taken to farms, plants or nurseries and shown how a particular aspect of agriculture relates to the total food system.
- Planning. Is more specific planning needed to protect agriculture, such as buffer zones or designated urban districts? What actions should be taken now?
- Name. Do agriculturists need to change their name? Perhaps their name should more accurately reflect the total picture of what they do. Should there be a Department of Food and Fiber, or a College of Food, Agriculture and Natural Resources?
- Investment. Citizens, producers, researchers and educators need to work hard to ensure that the State of Maryland invests appropriate amounts in its largest and most important industry. The state's investment must reflect the importance of this industry.
- Proactivity. Should there be a group that looks at practices that need to be modified, alternative courses of action that need to be taken, or other issues important to the food and fiber industry?
- Alternatives. What alternative commodities are viable for Maryland? How are these determinations made and should the infrastructure be developed?
- A systems approach. Is a total systems approach to the food and fiber industry needed? How would the appropriate groups become involved?
- Unified voice and strategies. The agricultural community should "speak" with one voice and develop coordinated strategies, rather than the multitude of special interests that currently exists.
- Conference work groups. The Wye Conference suggested work groups in a number of areas, such as marketing, alternative agriculture and water. Some of these are in place; others are necessary. Maryland needs a group to monitor and help bring about the results of this conference.

Whatever is concluded during the course of this conference, this opportunity—to identify the factors necessary to have a viable future for Maryland agriculture and to develop a system to ensure that goals are accomplished—is a milestone.

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Competitiveness of Maryland Agriculture

Bruce Gardner

Indicators of Maryland's Competitiveness

How well does Maryland agriculture compete with agriculture elsewhere in the United States? To answer this question, a specific definition of competitiveness is required. Only using technical efficiency measures (for example, yield per acre) or a productivity index as an indicator of competitiveness is not satisfactory. Maryland may have very high productivity in beef cow and calf operations in the sense that many calves can be produced on an acre of lush pasture land. But Maryland land is too expensive for this use. Other commodities may not be produced competitively in Maryland because farm labor is relatively expensive. In short, the state easily can be highly productive in producing commodities yet not be competitive in producing them.

A better indicator of competitiveness is the cost of a unit of output that is delivered to the consumer. This brings in not only input costs such as land and labor, but also marketing costs, quality and consistency of goods, and reliability of supply. Unfortunately, these factors cannot be measured easily, and in some cases, not at all.

In the end the best measure is an indicator of competitiveness based on observed product flows. If Maryland imports a commodity it is not competitive. Measured competitiveness increases if the state imports less or exports more. Because it is difficult to assess the quantities of some commodities consumed in Maryland, a roughly equivalent measure is more convenient—Maryland's share of the national production of a commodity.

Trends in Maryland's share of some categories of agricultural commodities are shown in Table 1. These figures are from the **Census of Agriculture,** with data from 1982. Data from 1986 are available in the U.S. Department of Agriculture's (USDA's) *Economic Indicators of the Farm Sector: State Financial Summary,* but these data are less complete in commodity detail. In 1986, Maryland's cash receipts for agricultural commodities totaled $1.185 billion, compared to $135 billion for the United States as a whole. Maryland accounted for roughly .9 of 1 percent of the U.S. agricultural output (1.185/135 = .0088). This is small—California's share is 10.3 percent, Iowa's is 6.7 percent, and even New York's is twice Maryland's share. But Maryland is not declining agriculturally; its share of U.S. farm receipts was less in 1950 than it is currently (Table 1).

Shares alone can be misleading, however. For example, Maryland's share of U.S. soybean acreage declined from .8 of 1 percent in 1950 to .6 of 1 percent in 1982; yet Maryland soybean acreage increased by a factor of six times, from 10,000 acres in 1950 to 65,000 acres in 1982. Just because acreage increased even more rapidly elsewhere does not mean that Maryland soybean production has been a dying industry. On the other hand, Maryland's share of the U.S. tobacco industry held up well through 1982 (it has declined since), but tobacco acreage is declining nationwide, so maintaining Maryland's share is compatible with Maryland tobacco being a declining industry. Broilers is another case in which economic activity in Maryland has increased substantially even though Maryland's share in the industry has declined since 1950.

Perhaps the most striking trends in Maryland crops concern the traditional agricultural raw material commodities (grains) compared to the higher valued, more specialized commodities of the vegetable and fruit family. Since 1950 the acreage of potatoes (Irish and sweet) and other vegetables in Maryland has declined more rapidly than for the traditional crops, as has Maryland's share in the U.S. output. In the 1930's, Maryland had 60,000 acres of tomatoes; in the 1980's, Maryland has 5,000 acres of tomatoes. Just since 1978 there have been dramatic declines in the acreage of lima beans,

Table 1. Maryland and U.S. output of selected commodities

	1982		1978		1950	
	Maryland	United States	Maryland	United States	Maryland	United States
Value of agricultural products sold ($ billions)	1.0 (.008)[a]	132	0.8 (.008)	108	0.17 (.006)	28.5
Field corn (thousand acres)	724 (.009)	77,883	675 (.009)	79,115	448 (.005)	83,336
Wheat for grain (thousand acres)	138 (.002)	70,910	72 (.001)	54,456	304 (.004)	71,161
Soybeans (thousand acres)	413 (.006)	64,833	371 (.006)	61,833	78 (.008)	10,148
Tobacco (thousand acres)	27 (.030)	913	21 (.022)	949	47 (.029)	1,599
Broilers (million birds)	267 (.064)	4,151	199 (.050)	4,000	55 (.087)	631
Potatoes (thousand acres)	2.9 (.002)	1,268	2.8 (.002)	1,485	15.3 (.008)	1,906
Vegetables (thousand acres)	38 (.011)	3,331	51 (.014)	3,569	104 (.028)	3,718

[a] Numbers in parentheses are Maryland's value divided by the U.S. value, i.e., Maryland's share of the U.S. output.

snap beans and peas. These trends must be assessed in order to consider the prospects for revitalizing Maryland agriculture by promoting vegetable crops.

As is revealed by the data in Table 2, plotted in Figure 1, the number of farms in Maryland is small (less than 1 percent of the U.S. total) and declining. Nonetheless, the rate of decline is slower in Maryland than elsewhere. Thus, Maryland in the 1980's accounts for a larger fraction of U.S. farms than at any time in post-World War II history.

Economic Forces Underlying These Trends

Throughout this century until the mid-1970's, farms had been growing larger in the United States and in Maryland according to statistics from the postwar U.S. censuses of agriculture (Table 3 and Figure 2). As the ratio column shows, farms in the United States are growing more rapidly than in Maryland. The economic meaning, causes and implications of this lack of growth are not fully understood; however, one factor may be the increased number of people, both in Maryland and nationwide, who are part-time farmers or who at least have a substantial nonfarm income source. Probably such farmers caused a decrease in the size of farms since the mid-1970's, but an increase in farm numbers in the 1970's and 1980's.

More directly relevant to competitiveness are productivity measures and input prices. Productivity can be measured partially by indicators such as crop yield per acre or milk produced per cow. Trends since 1950 in yields of corn, wheat, soybeans and milk per cow are shown in the following figures. For each commodity a chart is shown for Maryland and for the United States as a whole. Maryland's corn yields were above the U.S. average level in the 1950's but have been below the average since 1975 (Figure 3). In the last 4 years Maryland corn yields have averaged 35 bushels per acre below the United States as a whole. This suggests a loss of competitiveness.

Table 2. Number of farms

Year	Maryland (thousands)	United States (thousands)	Ratio of Maryland to United States
1950	36	5,388	.0067
1954	32	4,782	.0068
1959	25	3,711	.0068
1964	21	3,158	.0066
1969	17	2,730	.0063
1974	15	2,314	.0066
1978	16	2,258	.0069
1982	16	2,241	.0072

In both the United States and Maryland, the rate of growth of corn yields has slowed in recent years. This slowdown is more obvious when the time series is plotted on a log scale (so that the slope of the trend line gives the rate of growth). All the U.S. corn yields since 1973 lie below the 1950–1973 trend line (Figure 4). The slowdown in Maryland is even more striking with essentially no increase since 1973.

The story of wheat yields is different with respect to Maryland's performance, which raises the question of how much the subpar corn performance results from unfavorable weather. Although Maryland's wheat yield has accelerated in the 1980's, the U.S. average has stagnated (Figure 5). The wheat and corn yield trends appear anomalous. Maryland farmers are planting more corn acres and fewer wheat acres.

Soybean yields in Maryland have been below the U.S. average in the last 4 years, but this also occurred during 4-year periods in the 1960's and the 1950's (Figure 6). However, the rate of growth, which is the same for the United States as a whole and for Maryland, has been stagnant since 1970.

Milk production per cow (Figure 7) has been increasing at a rate of about 3.1 percent annually during the 1950 to 1986 period in both the United States and Maryland. (In comparison, the rate of growth of U.S. soybean yields is 1.5 percent annually in this period). Maryland production per cow has been just above the U.S. average for the whole period except briefly in the early 1960's. Thus, there is no evidence here of a loss of competitiveness for Maryland's dairy farms.

The yield data are all partial productivity indicators and for that reason may be misleading. For example, a reason given for the falling off of yield growth in the 1970's was reduced fertilizer and chemical use when the price of oil and related inputs rose during the "energy crisis." This caused reduced output per acre but did not necessarily reduce productivity as measured by a more comprehensive measure that divides output by an input index of land, fertilizer and chemicals.

USDA publishes a measure of total factor productivity. An index of aggregate crop and livestock output is divided by an index of land, labor, capital and other inputs. This productivity index is not published for individual states, but it is published for regions. A comparison between the United States and the Northeast region, which includes Maryland, is shown in Figure 8. Productivity in the Northeast has grown slower than in the United States as a whole, especially since 1970.

In spite of the increase in acreage of corn and soybean crops, the decline in yields is the only indicator of a loss in productivity of Maryland agriculture and possible source of a competitiveness problem. However, productivity is only half of the competitiveness story. The other half is the cost of inputs.

The two inputs most likely to cause competitiveness problems for Maryland are labor and land. Maryland and U.S. average farm wage rates are shown in Figure 9. Real farm wages (adjusted for cost-of-living increases) have increased by about 45 percent between 1950 and 1985. But farm wage rates have increased just as much elsewhere in the country. Real farm wages fell during the 1980's as compared to the late 1970's, but again the picture is roughly the same for Maryland as for the United States as a whole. So labor costs neither increased nor decreased Maryland's competitiveness.

Table 3. Acreage per farm

Year	Maryland	United States	Ratio of Maryland to United States
1950	112	216	.52
1954	120	242	.50
1959	138	303	.46
1964	153	352	.44
1969	163	389	.42
1974	174	440	.40
1979	168	449	.37
1982	158	440	.36

Land prices, however, could well have created problems of competitiveness for Maryland agriculture. Data on the value of farms are provided in Table 4. There has been growth in the value of farmland throughout the United States, but phenomenal growth in Maryland. Maryland farmland sold for a little more than twice the U.S. average price per acre in 1950, but over three times the U.S. average price in 1988. Note also that the sharp decline in U.S. farmland prices since 1981 has hardly affected prices in Maryland. These data appear in a different perspective; the price of land is deflated to

Table 4. Value of Maryland and United States farms

	Dollars/Acre		Ratio of Maryland to United States
Year	Maryland	United States	
1950	125	65	1.92
1954	177	84	2.11
1959	284	115	2.47
1964	422	144	2.93
1969	640	194	3.30
1974	1,060	336	3.20
1978	1,719	619	2.78
1982	2,376	823	2.89
1983	2,121	788	2.69
1984	2,185	782	2.79
1985	2,097	679	3.09
1986	1,887	595	3.17
1987	1,831	547	3.35
1988	2,014	564	3.57

obtain values in real terms (Figure 10). Real land prices have declined since 1980 in both Maryland and the United States, but in relative terms Maryland prices remain higher and with an increasing spread. Thus, land prices are the clearest indicator of a possible source of declining competitiveness of Maryland agriculture. Maryland appears less and less suited, in terms of a comparative advantage, as a location for producing land intensive goods.

Marketing Issues

High land prices mean high costs for land intensive goods, but these goods will still be produced if there is a strong local demand for them and the goods are costly to transport. Services such as golf courses or recreational horse or hunting operations, can survive high land prices if the local economy is strong. This fact is pertinent for agricultural products with a large service component and high transport costs such as nursery and greenhouse products. Competitiveness problems do not exist for these commodities.

The marketing side appears important in explaining the acreage of two categories of Maryland crops: the growth in feed crop acreage and the decline in vegetable acreage. Feed crops are demanded by the livestock feeding industry, particularly the broiler industry in Delmarva. Corn should be expected to bring a premium price near the point of consumption since transport costs are saved. Maryland corn sells at a premium over the U.S. average farm price of corn. But the premium has not increased over the past 35 years. The Maryland price has averaged 8 percent above the U.S. price, but the trend line is flat (Figure 11).

Marketing considerations appear to have worked against the Maryland vegetable industry, however. Local buyers claim sources other than Maryland are more reliable over a longer season and have a more uniform quality on a larger scale. The sources of the marketing problems must be investigated to see if they are inevitable or reversible, but such an investigation is beyond the scope of this paper.

Resource Issues

In the 1970's and 1980's, it has been increasingly recognized that a key input in agriculture goes beyond land, labor and capital—it is the natural resource environment in which agriculture operates. Heavy use of fertilizers, particularly nitrogen, uses up not only the fertilizer, but also the water that leaches excess fertilizer from the root zone. The costs of reduced water quality in ground water, rivers and the Chesapeake Bay are real costs of farming in Maryland and are beginning to be taken into account.

The effect of environmental and resource issues on competitiveness is not straightforward because it is the relative position of Maryland that counts. Some reports indicate, for example, that Iowa is having more severe ground water quality problems than are certain states. If this becomes generally true for the Midwest as compared to Maryland, then ground water problems will enhance Maryland's competitiveness even though Maryland has these problems.

FIGURE 1: NUMBER OF FARMS

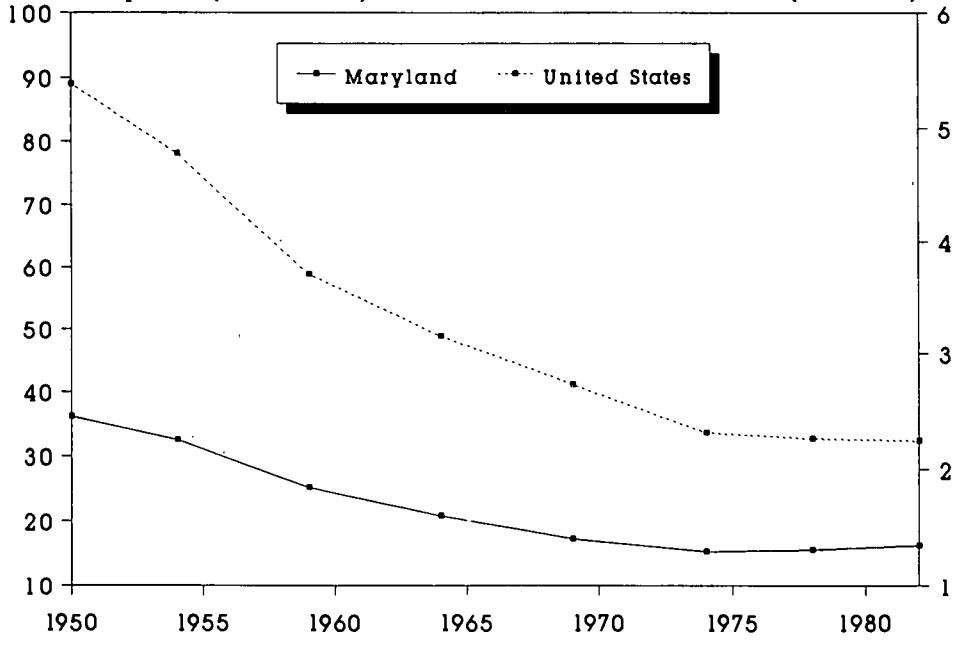


FIGURE 2: ACRES PER FARM

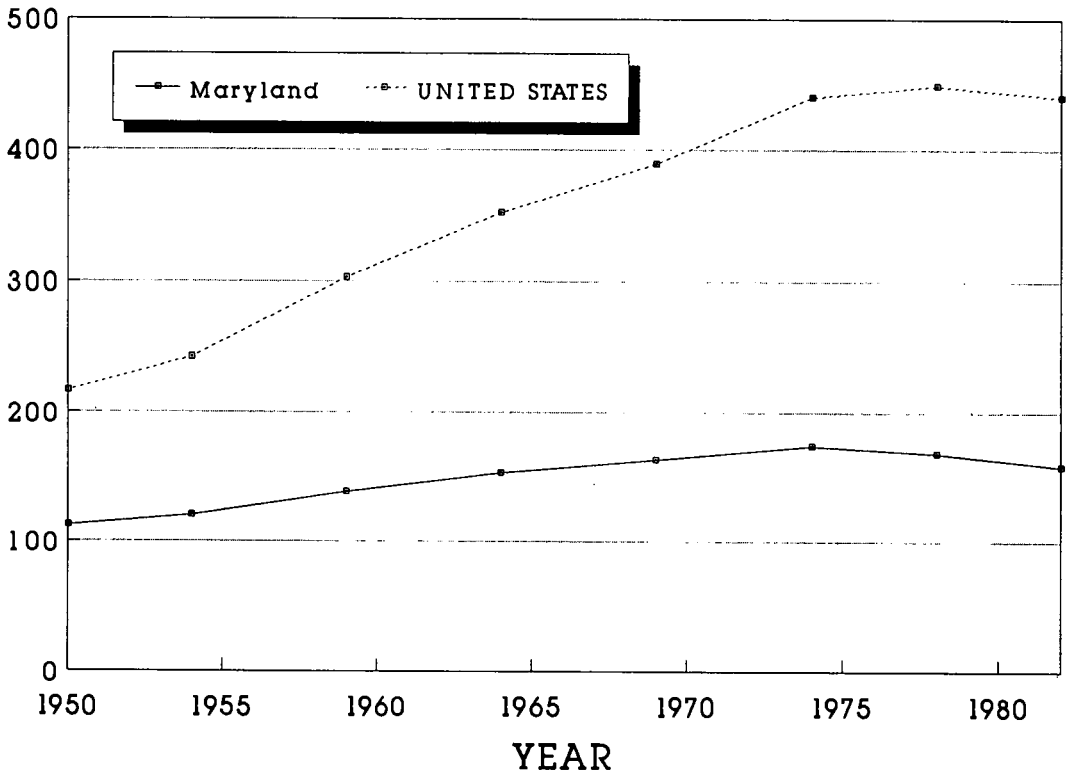


FIGURE 3: CORN YIELDS

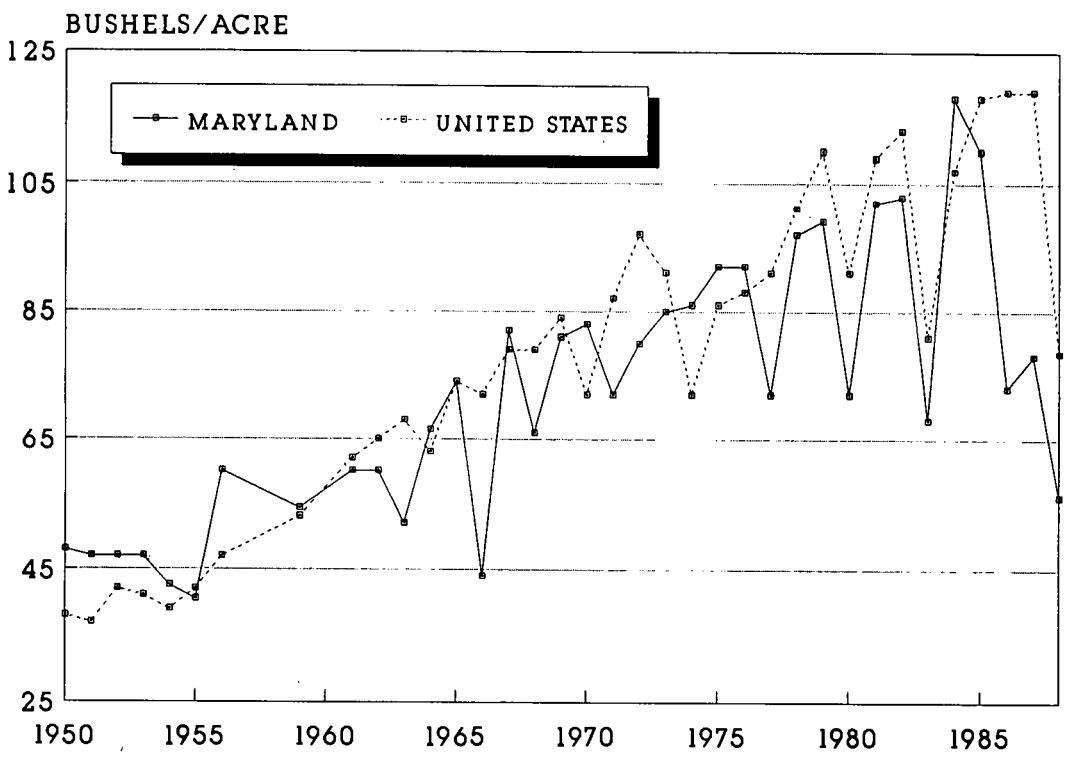


FIGURE 4: LOG SCALE OF CORN YIELDS

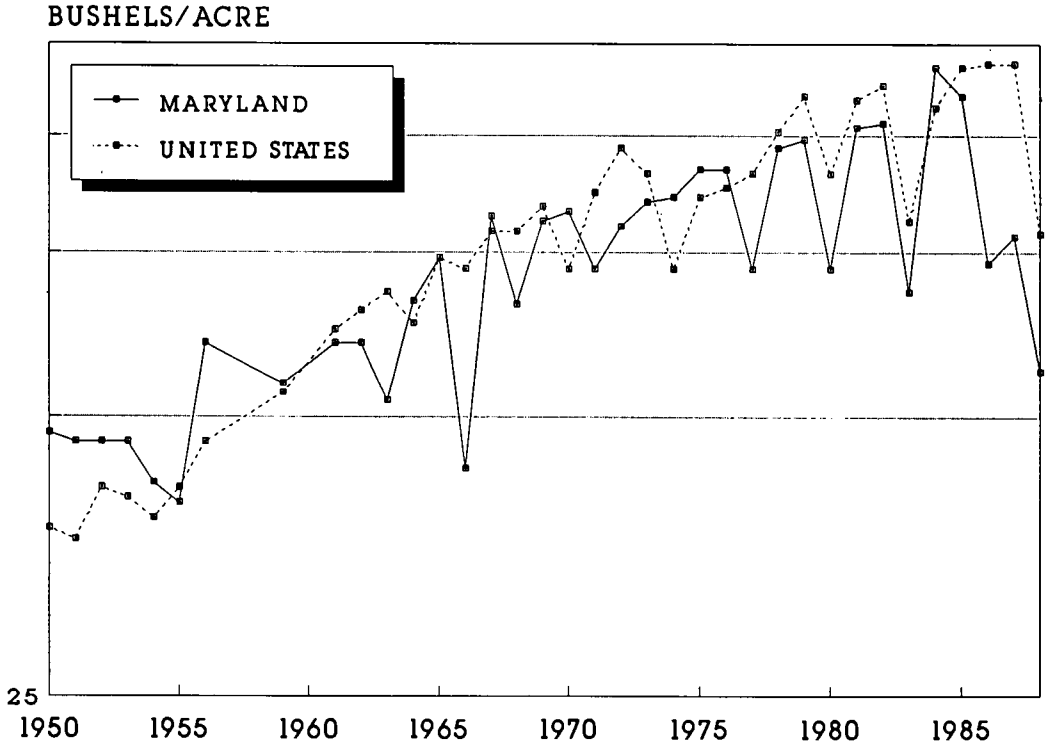


FIGURE 5: WHEAT YIELDS

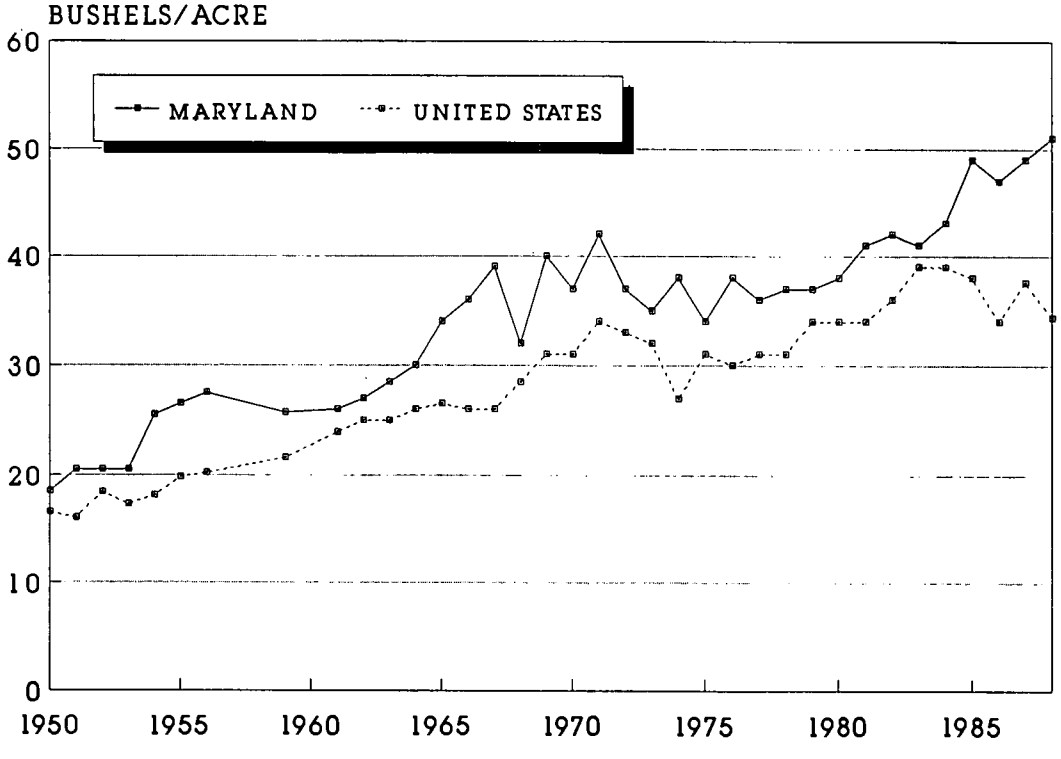


FIGURE 6: SOYBEAN YIELDS

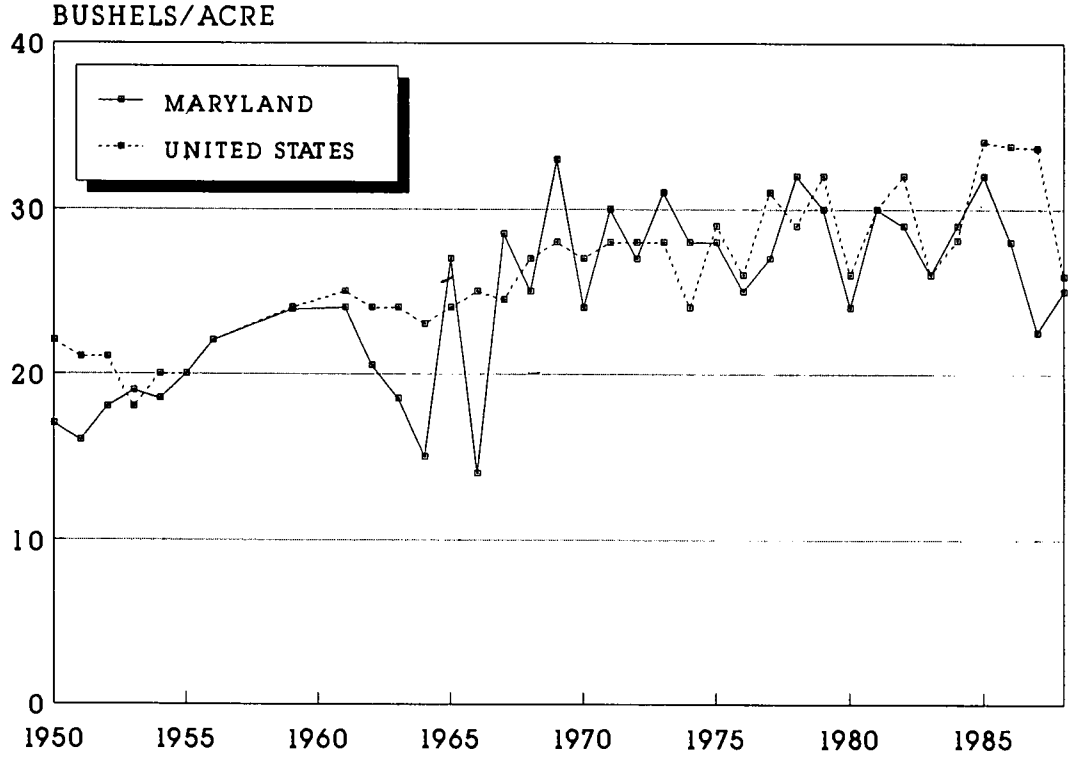


FIGURE 7: MILK YIELD PER COW

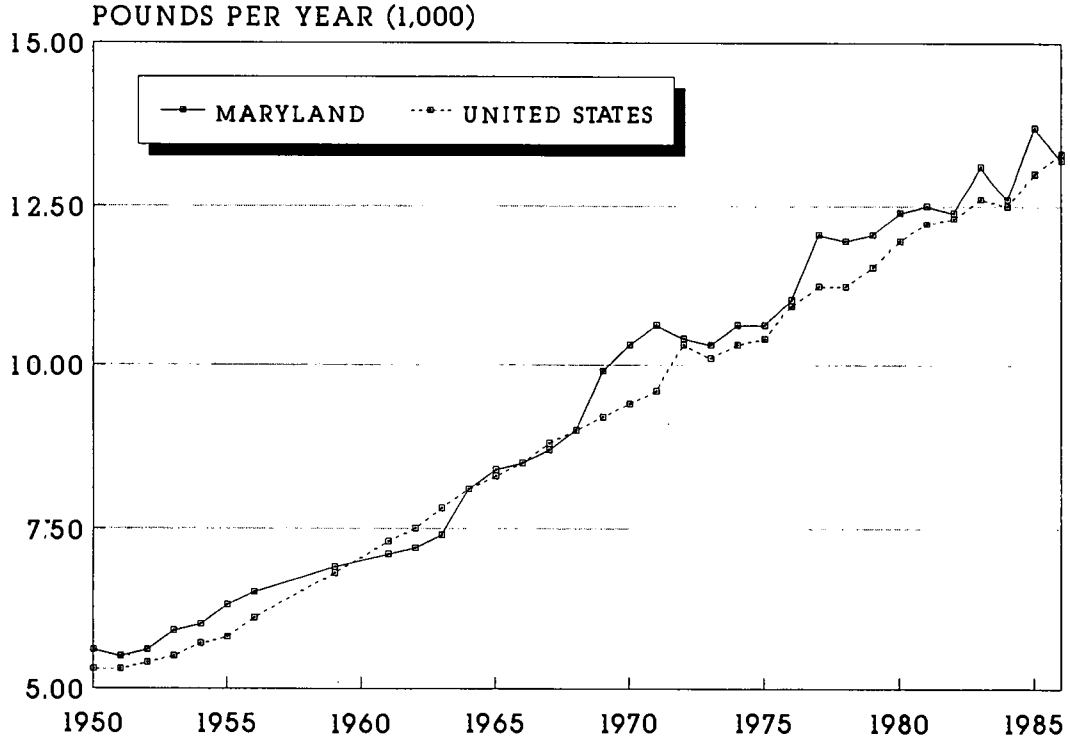


FIGURE 8: AGRICULTURAL PRODUCTIVITY 1947-1986 (LOG SCALE)

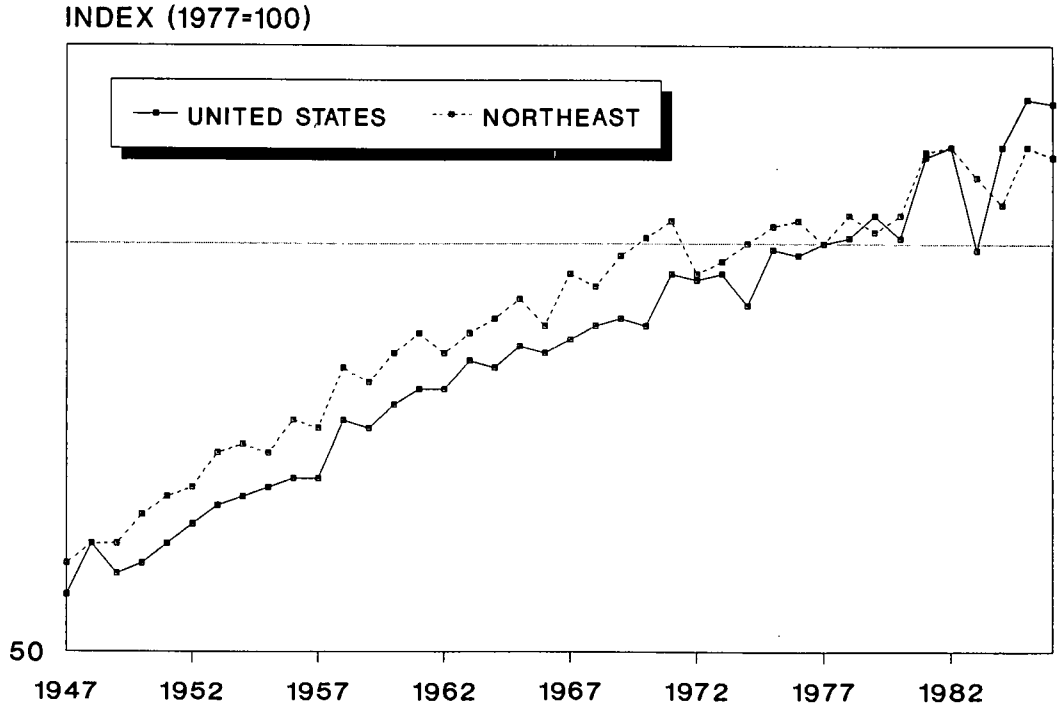
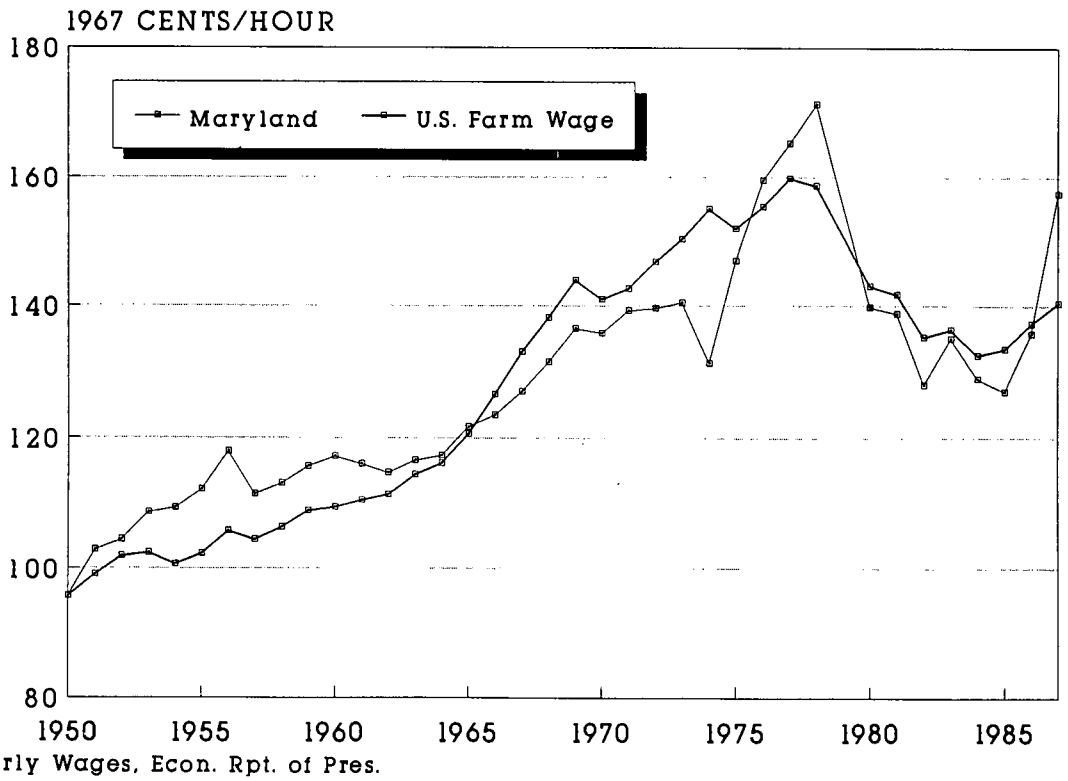
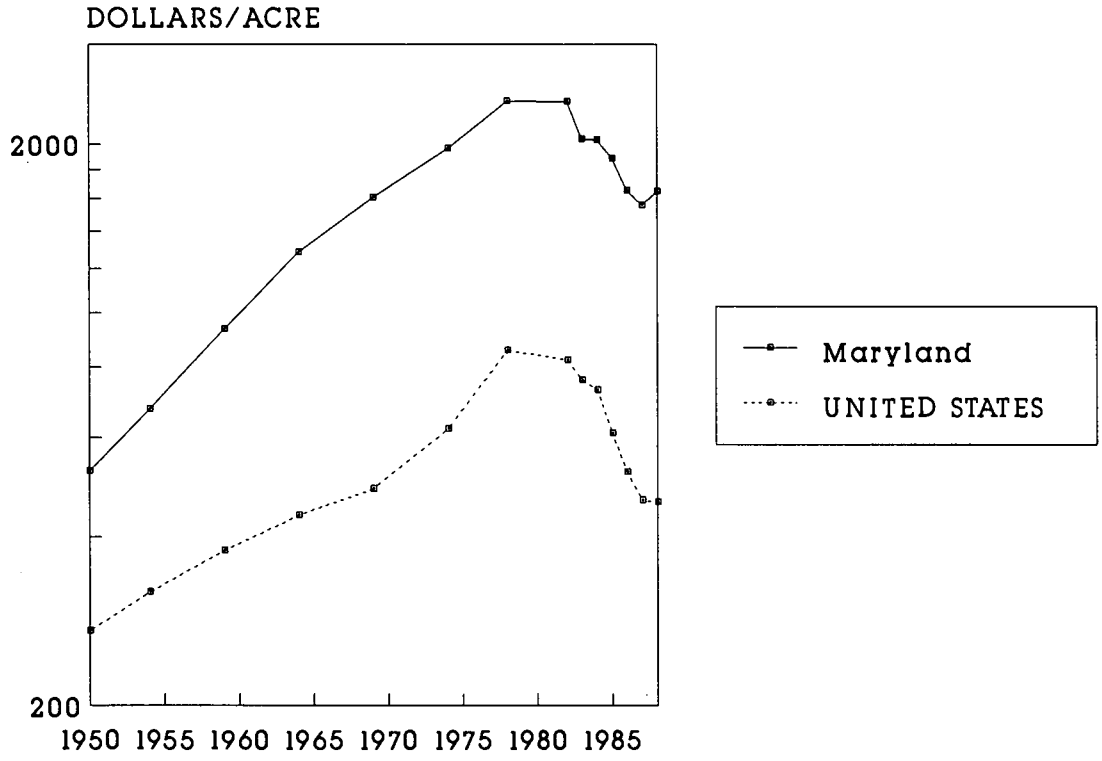


FIGURE 9: REAL FARM WAGE RATE



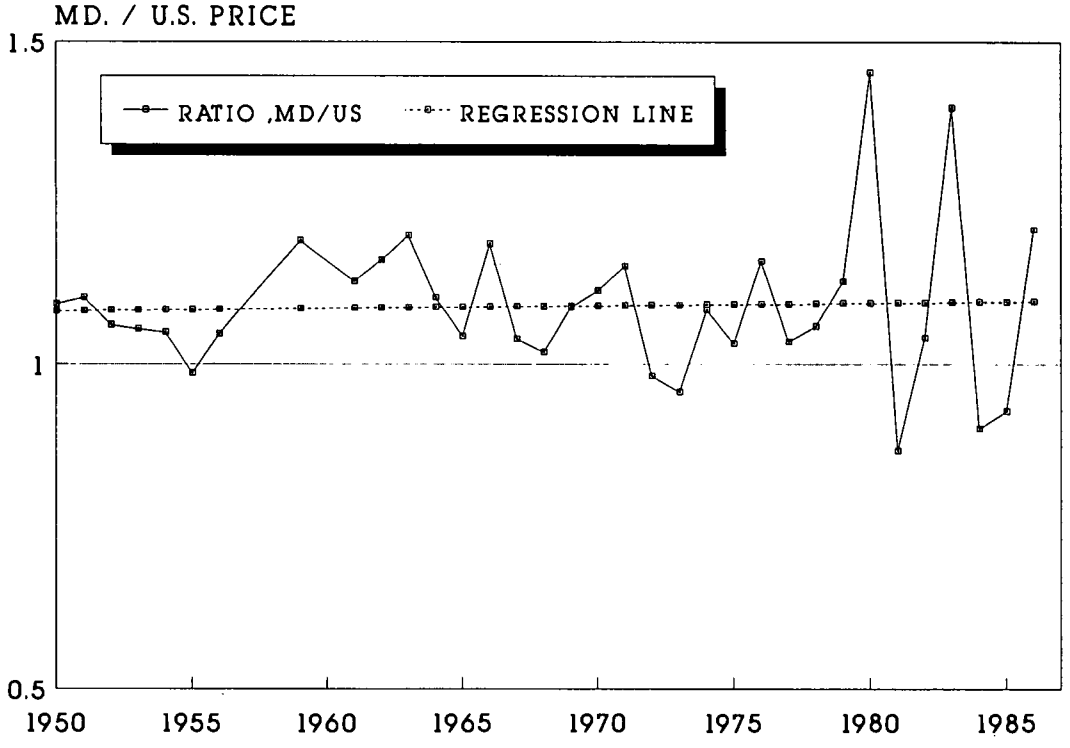
Hourly Wages, Econ. Rpt. of Pres.

FIGURE 10: REAL FARM VALUE



Log Scale, Prices Deflated By GNP Defl.

FIGURE 11: CORN PRICE RATIO



The Effects of Emerging Biotechnologies on Maryland Agriculture

Darrell Hueth and Shain-Dow Kung

Introduction

The development and adoption of new agricultural technologies have made U.S. agricultural producers and processors among the most productive in the world. As a result, American households spend a smaller percentage of their income on food than households in any other country. Concern has been expressed, however, about whether the record of increasing productivity gains in agriculture can be sustained. The mechanization of agriculture is now complete, and the adoption of the chemical inputs developed for agriculture following World War II is widespread. Fortunately, scientists agree that another major technological revolution has started—a biotechnological revolution. It is argued that biotechnology has the potential to allow the United States to increase its agricultural productivity and hence maintain its competitiveness in world markets.

Biotechnology has two characteristics that are significantly different from previous agricultural technologies. First, biotechnology can be used to enhance product quality by improving characteristics of plants or animals. Second, and particularly important with respect to Maryland, biotechnology has the potential for conserving natural resources and improving environmental quality.

Current Status and Prospects of Agricultural Biotechnology

Biotechnology has its roots in agriculture and presents important opportunities for Maryland. Powerful tools have been created to carry out the purpose of agriculture—to intelligently use natural resources for the production of more and better food and fiber products. The tools of biotechnology differ from traditional methods primarily in their speed, precision and reliability.

The use of technologies based on biological systems and living organisms includes recombinant DNA, gene transfer, embryo manipulation and transfer, plant regeneration, cell culture, monoclonal antibodies and bioprocess engineering (Board on Agriculture 1987). These techniques can be employed to discover information about elucidating gene structures, functions and regulations, characterizing photosynthesis, diagnosing diseases, developing and using growth hormones, and clarifying the process of nitrogen fixation.

Over 60 companies in the United States are attempting to develop a variety of agricultural products using biotechnological techniques. Some of these companies are small and entrepreneurial in nature and others are Fortune 500 companies. Large agricultural chemical companies have shown significant interest in biotechnology since many of the products envisioned are potential substitutes and in some cases complements to products they are now producing.

At present, there are developments involving animals, which are closer to the market than those involving plants (Table 1). For example, scientists have been able to genetically engineer bacteria to produce the growth hormone bovine somatrotrophin (bst). When bst is administered to lactating cows under experimental conditions it causes an increase in milk production up to 40 percent. This hormone is expected to be on the market in 1990 or shortly thereafter. A growth hormone also has been engineered for swine, which increases their ratio of muscle to fat and elevates their growth rates. This technology is somewhat further from the market.

Table 1. Emerging biotechnologies

Product or Process	Biotechnology	Years to Develop
Animal		
Enhanced dairy production	Engineered growth hormone (BGH)	0
Enhanced growth rates for swine	Engineered growth hormone (PGH)	2
Pregnancy and estrus testing	Monoclonal antibodies	1
Multiple offspring	Gene mapping booroola gene	2 – 5
Disease prevention and control	Monoclonal antibodies	1 – 5
Enhanced aquaculture production	Engineered growth hormones—cold tolerance	3 – 5
Disease protection multiple diseases	Vaccinia virus	5 – 10
Increased feed efficiency	Engineering of intestinal organisms	5 – 10
Plant		
Herbicide resistance	Genetic transfer	0
Frost resistance	Genetic transfer	0
Plant regeneration	Cell culture	0
Insect resistance and control	Pheromones, juvenile hormones, genetic engineering	0
Disease detection and control	DNA probes and genetic transfer	0 – 5
Protein enhancement	Genetic transfer	2 – 5
Enhanced nitrogen fixation	Symbiotic rhizobium	5 – 10
Direct nitrogen fixation	Genetic engineering	10 – 20
Heat tolerance	Genetic transfer	5 – 10
Salinity tolerance	Genetic transfer	5 – 10

Other technologies currently being developed include those that produce multiple offspring and vaccines for disease prevention and control, as well as those that enhance aquacultural production. Faculty members of veterinary medicine at College Park have prepared monoclonal antibodies against neutralization sites on infectious bursal disease (IBD) and Newcastle disease viruses (NDV). Examples of technologies that are "over the horizon" include those that can provide protection from multiple diseases using the vaccinia virus as a carrier and engineered microorganisms for increased feed efficiency.

There are many more transgenic plant species than animal species. Hence the potential developments in plant biotechnology may, in fact, be more numerous than those in animal biotechnology. The majority of plant biotechnology research thus far has focused on developing plants that reduce losses caused by insects and diseases, resist frost damage, and tolerate certain herbicides. Insect resistance research has centered on inserting a gene into plants or bacteria obtained from the bacteria bacillus thuringiensis (BT). The gene produces a toxin that is fatal to insects. Efforts have concentrated on the use of BT because it has been used commercially in agriculture for 25 years and dissipates rapidly in the environment. Field trials were conducted recently in Maryland using this technology to protect corn against the European corn borer.

Herbicide resistance research has focused on developing tomato and tobacco cultivars that are resistant to herbicides such as glyphosate (Roundup). Environmental groups have expressed concern about the benefits from this research since it is not clear whether it will lead to increased or decreased use of herbicides. The commercialization of these plant technologies may be 5 to 10 years away as a result of economic incentives, environmental regulation and public acceptance. For example, a major economic consideration will be whether or not the cultivars produce fruit that meets the standards of the processors.

Plant technologies that involve multigenic traits such as nitrogen fixation and stress tolerance are even further away. Researchers are concerned because plants that are engineered to produce nitrogen may use so much energy in doing so that yields may fall dramatically. Much more needs to be learned about genetic structure, gene function and gene regulation before these technologies become available.

Potential Impacts of Agricultural Biotechnology

Biotechnology can have significant impacts on agriculture. In Maryland, five areas are particularly relevant: (1) production levels, (2) industry structure, (3) income distribution, (4) environmental quality, and (5) labor and management requirements.

Production Levels

Bst is the only biotechnological development that has been subject to intensive evaluation thus far. Early esti-

mates were that production per cow would increase by 40 percent. More recent estimates (Fallert et al. 1987) have been in the 10 to 20 percent range for typical dairy herds and dairy managers. Also, there have been some production problems encountered with cows coming off a bst lactation and in some cases the width of the cows does not seem adequate to support the size of the udder. Still, there is a significant increase in productivity expected. The dairy industry, however, has had significant increases in productivity even without bst. From 1960 to 1982, milk output per cow increased 2.6 percent annually. Thus, it is likely that bst will accelerate dairy production, but not dramatically.

Studies of the effects of bst adoption show that there will be only minor changes in regional production patterns. Under the most likely scenario, farm numbers in the Northeast are projected to decrease by about 2.6 percent by 1996 with bst, but are also projected to decrease by 2 percent without bst. The region which is projected to show the smallest decrease in farm numbers is the Southeast which has higher milk prices than other regions because of Federal milk order differentials. Other animal biotechnologies are not expected to have significant impacts on regional production patterns in the near future.

Experimental studies of the use of growth hormones in meat production have shown that weight gain by hogs can be increased from 6 to 20 percent and a single study for beef cattle found a gain rate of 25 percent during an 18-week period. Feed efficiency also has been shown to increase from 10 to 30 percent. It is considered unlikely, however, that these gains in efficiency can be achieved in cattle feedlots and hog pens. Moreover, since swine and beef cattle generally are less confined than dairy cows, the labor and management required for daily injections could substantially increase costs and adversely affect adoption rates. Still, there are significant increases in animal productivity expected in the next 5 years.

Plant technologies that increase productivity are not likely to enter the market this early. A recent study by the U.S. Office of Technology Assessment (1986), indicates that plant biotechnologies will not have a major effect on aggregate agricultural productivity until the late 1990's or early 21st century and, annual increases in yields are not projected to differ significantly from historical averages between now and the year 2000.

Structure

Agricultural biotechnology may have a greater impact on the structure of agriculture than on production levels. The technological revolution in farm machinery resulted in the largest farms becoming the most efficient farms while the chemical revolution tended to be scale neutral. Agricultural biotechnology generally increases the complexity of farming (although some developments such as pest-resistant cultivars make crop production less complex). On balance, increased complexity of management tends to favor larger farms over smaller farms.

Also, the major beneficiaries of these technologies will be the early adopters. These producers will expand their scale of operations to take advantage of the technology. The increased output from this group will depress prices and reduce profits for nonadopters. Some nonadopting producers will be forced out of business. Thus the numbers of farms and farmers are likely to continue to decrease as a result of biotechnology, and farms are expected to get larger.

In the long run, greater changes in the structure of agriculture are possible through biotechnology. The control of genetic characteristics has been a major factor in the vertical integrations of several agricultural industries, for example, the Perdue chicken. It has been pointed out (Phillips 1988) that the greater control of genetic factors through biotechnology could lead to the integration of other industries such as pork, beef, vegetable and fruit industries.

Income Distribution

The income distributional impacts of biotechnology on agriculture are not limited to consumers and producers. Although no immediate regional or international implications have been identified, possibilities exist.

Insofar as the technical change is either productivity increasing or cost reducing, the effect on consumers will be positive. That is, increased supplies will lead to lower prices and consumers will be better off. This of course holds true whether the consumers are households or are agribusiness firms that use farm products as inputs. For example, a recent study by the U.S. Department of Agriculture (USDA) shows that even under the price supports provided by the 1985 Farm Bill, the overall milk prices are estimated to fall by 9 percent with the introduction of bst. Milk prices would fall even further were it not for the government purchases of dairy outputs.

"Biotechnology differs most significantly from previous technologies in its distributional impacts, because the quality of agricultural products is improved."

The demand for most agricultural products is highly inelastic. This means that without governmental intervention small increases in supplies result in large price decreases. The gains producers make by being able to sell a larger quantity are offset by the reduced prices they receive for their products. Even the early adopters of new biotechnological tools may not be better off as the market effects of their decisions are realized. Again, the government can cushion these adverse effects on growers, but the current concern throughout the country about budget deficits suggests this will not continue indefinitely.

Biotechnology differs most significantly from previous technologies in its distributional impacts, because the quality of agricultural products is improved. A recent paper by Stevens (1988) reports that consumers are willing to pay more for food products which look better, taste better, are safer (because they contain less pesticide residues), and are more nutritious. Biotechnology, often called the designer technology, is now being directed toward all of these ends. Successful research in this direction will mean growers can produce more and still demand higher prices for their products. The primary beneficiaries from increased food quality will be farmers. However, consumers can be no worse off as food products of improved quality are introduced. The only possible losers are producers of products for which these new food products will substitute. Thus research directed toward improving food quality can make both Maryland consumers and Maryland producers better off.

Although regional impacts of plant biotechnologies have not been studied at this time, it is possible to do some speculation. Current work on these technologies is directed toward reducing crop losses. Thus it would seem that the regions that have the greatest to gain are those that are currently experiencing the greatest losses from insects, weeds and diseases. This suggests that the Southeast, including Maryland, may be a major benefactor of plant technology. The upper plains area stands to benefit little. Maryland has significant pest and disease problems that are ideal candidates for biotechnological solutions. Of course, if competitive regions experience greater cost reductions than Maryland, the state could still lose a share of its national market. Thus there is a clear need for further research on the regional economic impacts of plant as well as animal biotechnologies.

Finally, biotechnology research currently is concentrated in developed countries, but developing countries undoubtedly will require biotechnological developments to increase their agricultural self-sufficiency. The creation of plants that are drought resistant may enable African nations to produce far more food than currently is possible. Also, the Soviet Union, which traditionally has been a large grain importer, may be able to grow crops in far colder regions and thus reduce imports. If biotechnological developments in the United States do not keep pace with those elsewhere, the United States will become less competitive in world markets and Maryland producers will be adversely affected.

"Future farm managers and workers will have to be able to inject hormones, carefully balance rations, identify insects and diseases, transfer embryos and carefully monitor environmental conditions."

Environmental Quality

Biotechnology is expected to reduce the land and water resources required for agricultural production. It also is expected, on balance, to reduce the use of chemical inputs. Thus biotechnology can enhance surface and ground water quality, soil productivity and wildlife habitats, and reduce health risks associated with agricultural chemicals.

Concern has been expressed, however, that genetically engineered organisms released into the environment may have unforeseen impacts. Weeds, for example, may acquire the genetic material from herbicide-resistant plant cultivars. Also, ecological systems may be disrupted by introducing an organism with no known predators or parasites into the environment. The Federal government is regulating the testing and approval of biotechnological products under a coordinated framework, which includes the Environmental Protection Agency, USDA, and the Food and Drug Administration. At present, there is no generally accepted methodology for assessing the benefits and risks of biotechnological products used in agriculture.

Labor and Management

Biotechnology will significantly increase the skills required by hired labor and management. Future farm managers and workers will have to be able to inject hormones, carefully balance rations, identify insects and diseases, transfer embryos and carefully monitor environmental conditions. Computers also will be used widely to monitor plant and animal performance and for farm financial analysis.

The demand for increased labor and management skills will be greater in animal production than in crop production. The use of bst in dairy production has been said to require the same level of management skills as three-times-a-day milking. Not all dairy farmers will immediately have the skills necessary to fully exploit this development.

The demand for unskilled farm labor will continue to decrease. Just as special tomato cultivars were bred to be used with the mechanical tomato harvester, new products will be engineered to be produced and harvested by mechanical means.

A Research Base

The Maryland Center for Agricultural Biotechnology

A task force on agricultural biotechnology proposed the formation of a Center for Agricultural Biotechnology (CAB) at the University of Maryland to invest in research that will benefit Maryland food consumers and agricultural producers and enhance Maryland's natural resources. CAB was foreseen as a means of propelling Maryland into a national and international leadership role in agricultural biotechnology. To accomplish these goals, CAB was established on July 1, 1987 as one of five centers under the jurisdiction of the Maryland Biotechnology Institute (MBI). At present there are 20 scientists being funded by this program, of which 7 are in new positions on the College Park campus. The principal guideline used in formulating the research programs is to capitalize on existing strengths, available talents and projects of importance to Maryland.

One area that has been identified is plant protection through biological control. Both the Entomology and Botany Departments at College Park have strengths in this area. The development of Maryland crops that are more resistant to insect pests and the development of beneficial insects that are more antagonistic to pests can reduce the growers' reliance on chemicals and improve the quality of the water and soil resources in Maryland.

Disease protection in poultry is a second area that has been targeted. The poultry industry is Maryland's largest agricultural industry. One of the highest priorities in that industry is to find vaccines that are safe, economical, predictable and effective. Should the IBD and NDV vaccines under development in the School of Veterinary Medicine prove satisfactory, considerable potential exists to cover all economically important poultry diseases.

Bioconversion is another area where the University of Maryland has an established area of excellence. The Chemical and Nuclear Engineering Department has a component in bioconversion, which is developing engineering techniques for large-scale fermentation with modern control strategies. These alternative uses for agricultural products can increase farmers' income. Also, products with a biological rather than petrochemical base such as bioplastics will improve the environment of the state.

Finally, CAB recognizes that all applied research stems from basic research. Thus some support will be provided for research to provide a better understanding of cellular and molecular mechanisms in biology and biochemistry.

Issues

What can farmers do to take advantage of emerging biotechnologies?

American farmers have always been eager to learn about and adopt technologies that can increase their profitability. To remain competitive, Maryland farmers and agribusinesses must have early knowledge about the use of emerging biotechnologies. They must know the land, capital and knowledge requirements to position themselves to take advantage of these developments. They will have to invest in upgrading their technical and management skills. In Maryland, nonfarm employment may be a viable option for those who do not have access to the resources to succeed in the age of high technology.

What changes are suggested for the Maryland Cooperative Extension Service (MCES)?

Biotechnology creates exciting opportunities and challenges for MCES. Extension historically has had the responsibility of transferring emerging technologies from the laboratory to the farm. But, heretofore, most of the research has emerged from the public research system while much of the biotechnological developments will come from the private sector. The more pressing questions for MCES are: 1) Should Extension be involved in the testing and delivery of emerging private-sector biotechnologies? and 2) Under what conditions?

Extension also has played a major role in developing the management skills of farmers and livestock raisers. Upgrading the farm management skills of Maryland growers would seem to be a clear priority for the future. Courses and workshops on biotechnologies are essential.

As farm enterprises become larger and more integrated, they will hire their own pest management specialists, nutritionists, veterinarians and management consultants. Extension may not be able to serve these producers. Where is the future farm clientele of Extension? Should Extension efforts be centered on preserv-

ing the moderate family farms as some have suggested (Knutson and Richardson 1988)?

Should the Maryland Department of Agriculture (MDA) have a role in the regulation of agricultural biotechnologies?

In many states, including Maryland, the State Department of Agriculture plays a major role in regulating the handling and use of pesticides. Is there a necessary similar function for MDA for biotechnological products? Does the presence of that grand estuary, the Chesapeake Bay, require that researchers look more closely at potential impacts on plant and animal communities and on ecosystem processes than the Federal government?

What is the appropriate relationship between the University of Maryland and the private sector in the development and commercialization of agricultural biotechnology?

The potential benefits from joint university-industry research have been widely recognized. Universities can gain relevancy for their applied research, job opportunities for their graduates, financing for their research, and royalties for their developments. Industry can keep abreast of basic research developments and in some cases obtain exclusive licenses for products developed.

Concerns have been raised about three issues: (1) the possible distorting effect of a small amount of private funds on the research agenda (Hueth and Just 1987); (2) the effect of industry interest in secrecy and confidentiality on the free interchange of scientific results; and (3) the possibility that a handful of scientists in the system would reap out of proportion financial gain from involvement in joint projects. Is sufficient attention being paid to these issues at the University of Maryland, and have guidelines been developed?

Will there be a need for educational and training programs for those who will leave the agricultural arena as a result of the biotechnological revolution?

The state of Maryland is fortunate to have one of the lowest rates of unemployment in the United States. Maryland ranks fourth in per capita income. There are, however, "pockets of poverty" in rural areas of the state and biotechnology may exacerbate conditions in these areas. Should special efforts be made by MCES to provide educational and training alternatives for those who may wish to leave the agricultural field?

How can researchers assure that environmental quality is properly accounted for in the development and implementation of new technologies?

Private biotechnology companies have an incentive to develop and market products that can be sold for the greatest profits. Some biotechnological products may not be produced because even though there are substantial environmental benefits their contribution to profits is less than others. For example, enhanced nitrogen fixation through rhizobium seed inocula may be possible technically but not economically feasible. Should incentive systems be devised and adopted to ensure that the technologies with the greatest social value are created and adopted?

The age of biotechnology will bring many benefits to Maryland. There will be trade-offs, but the net gains undoubtedly will be positive. The achievement of the full potential of this scientific revolution will require close cooperation of the state government, the university, public interest groups, and most importantly, the agricultural community of Maryland. Compromises and concessions will be essential for progress. Hopefully a start has been made.

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Aquaculture: An Alternative for Maryland Farmers

Ivar Strand and Douglas Lipton

Introduction

Recent droughts and subsequent losses have caused Maryland's agricultural community to reassess its operations and seek alternatives. There has been some interest expressed in having alternative crops such as vegetables, turfgrass and aquacultural products replace traditional Maryland crops such as tobacco and corn. Gardner (1989) demonstrated that it is not uncommon for major shifts in crops to occur in a state. For example, the Eastern Shore of Maryland shifted from a vegetable (tomato and potato) producer to a grain (corn and soybean) producer in the last 40 years. This shift primarily resulted from unanticipated events—the expansion of Maryland's poultry production and the rapid growth in prices of protein sources.

People who mention aquaculture as an alternative usually point to major events that are happening in the seafood market to bolster their argument. In 1987, U.S. per capita consumption of fish and shellfish was a record 15.4 pounds, a 20 percent increase since 1980. Seafood prices have been rising at the same time. The 1987 consumer price index for fish and shellfish increased 9.4 percent compared with a 2.7 percent overall increase in inflation. The demand for seafood appears to be blossoming at a time when seafood production seems to be sputtering.

The purpose of this paper is to assess the potential for aquacultural products as an alternative crop for Maryland farmers. Although the authors focus on hybrid striped bass as an alternative crop, their approach is general in several respects. The authors examine the potential for augmenting existing operations and using otherwise inactive land. This activity would likely be a flexible operation, not requiring a large capital investment or a great deal of risk. Next, a complete shift of operations, in which large ponds would be constructed on farmland is considered. This, however, would be capital intensive and bear high risk. In considering the scale of operation, both the likely unit costs of production and comparable costs in other states are examined. This establishes the geographic comparative advantage as well as a cost basis from which potential prices can be compared. Like all potential investments, the revenue potential for the product is explored. This requires understanding and projecting those factors, which will determine the prices of the hybrid striped bass. Finally, the authors conclude by examining the returns to investment with different market scenarios.

The need for this assessment arises from Maryland's regulation that hybrid striped bass should be considered as a striped bass, a threatened and endangered species. Because of this, few producers and markets exist and hence little data are available.

Why Consider Aquacultural Production?

Seafood demand has increased because consumers believe seafood is a healthy product. Recent studies indicate that regular consumption of seafood may lower the risk of heart disease. In addition, seafood is being eaten more because consumer incomes are up. Also, research shows there is a greater share of older persons

in the population than in the past, and these older individuals are more likely to eat seafood than younger persons.

On the supply side, most seafood comes from wild fish and shellfish populations. Many of these populations are being harvested at their biological limit of production or even overharvested. Thus, even though seafood prices are higher, it is difficult for producers to increase production. Prices will continue to increase as long as producers cannot respond by providing more product from the wild harvest. Examples of this phenomenon are evident in Chesapeake Bay fisheries with oysters and striped bass. There is currently a moratorium on the capture of wild striped bass in Maryland because of the severe depletion of the fish stock, and oyster harvests are at record lows because of overharvesting and oyster diseases. There is not a great deal of evidence suggesting a rapid resurgence of natural fishery production.

One way to overcome the natural limits on fish production is through aquaculture, the artificial control of some or all portions of a fish's environment. Aquaculture has been technically feasible for many years, but the current market conditions have made it economically feasible only for some species. In 1980, farmed salmon production was only 7,200 metric tons throughout the world. In 1987, led by Norway, world production reached almost 72,000 metric tons. Projections are for production to increase to over 225,000 metric tons by 1990.

"One way to overcome the natural limits on fish production is through aquaculture, the artificial control of some or all portions of a fish's environment."

The most valuable aquacultural product worldwide is farmed shrimp. In 1982, shrimp culture throughout the world accounted for 84,000 metric tons. In 1986, the figure had reached 309,000 metric tons and is projected to grow to 490,000 metric tons by 1990. U.S. shrimp imports increased 82 percent from 1982 to 1987, to a record 580 million pounds. It is assumed that most of that increase can be attributed to foreign aquacultural production.

Because of climatic conditions, it is doubtful that the United States will be a big producer of cultured shrimp. Salmon is being cultured on a small scale in the United States, but production may be limited by the availability of good coastal sites. However, domestic production of farm-raised catfish has proved to be very successful. In 1987, over 280 million pounds of farm-raised catfish were produced in the United States, a six-fold increase over 1980 production. It is interesting to note that most of this catfish production occurred in southern states where demand for the products is strong. However, catfish is slowly gaining acceptance in northern markets, and Mrs. Paul's has now added frozen breaded catfish to its frozen seafood product line.

Why Consider Hybrid Striped Bass Production?

Looking at the successful aquaculture industries around the nation and world, there are several obvious rules that emerge that should be followed in considering aquaculture in a region. The first rule is to choose a product that has strong local demand, if not national demand. Shrimp and the species of salmon that are being cultured command premium prices in the seafood market. The catfish industry has had a greater struggle in keeping prices at levels where culturing is profitable. Another rule to follow is to choose a product that will grow best in the climate. Shrimp culture in the United States is unable to outcompete culture in countries like Ecuador where three crops can be harvested from a pond in a year. Even in the warmer climates of the United States, two crops at most can be harvested.

A person in the Chesapeake region may consider oysters and striped bass for aquaculture. The culture of oysters will likely occur in Chesapeake Bay waters and not be an obvious alternative for farmers. Land-based culture of striped bass and its hybrid (a cross of striped bass and white bass) offer a possible alternative. There is a history of a strong regional (Northeast) market for striped bass, and its abundance in the Chesapeake Bay supports the concept that conditions in this region are favorable for striped bass production.

Striped bass and its hybrids can be raised in fresh water in cages or pens in existing farm ponds, or in specially constructed fish ponds. A discussion on the major factors in costs of production for these options and how Maryland compares to other regions that are potential producers follows. Also, the market for striped bass, and how it will be affected by policies concerning wild harvesting will be discussed.

The obvious question to address before examining the profitability issue is why hasn't hybrid production started on its own? If it is profitable, then profit-oriented

farmers would move into these operations on their own. One major reason is that hybrid striped bass are considered striped bass in many states and are regulated by law in the same manner that the wild fish are. It is presently illegal to possess either striped bass or hybrid striped bass in Maryland. The recently passed Aquaculture Act gives the Maryland Departments of Agriculture and Natural Resources the responsibility for developing regulations that will allow striped bass culture in Maryland. There are currently a number of aquaculture demonstration projects underway throughout Maryland.

Hybrid Striped Bass Production Costs in Maryland

There are thousands of acres of farm ponds in Maryland. They are traditionally used and designed for watershed conservation, irrigation, livestock watering or even recreational fishing (Harrell 1988). Many of these ponds, however, would not be suitable for commercial aquaculture because they cannot be drained adequately, or it would be difficult to harvest fish from them. The potential aquaculturist has two alternatives: (1) construct a pond designed for aquaculture, or (2) grow fish in cages or net pens in existing ponds. The potential aquaculturist should be interested in the relative production costs for these different alternatives, and how his or her particular cost situation compares with potential competitors.

Because there are very few commercial striped bass aquaculture operations in existence, it is difficult to obtain data on production costs. The following method, which is an economic engineering approach, is one way to approximate these costs. This approach entails an aquaculture expert providing information to an economist on how to construct and operate a hypothetical aquaculture enterprise. The economist then obtains prices for the various inputs, and determines the costs of construction and operation.

Costs of Constructing Fish Ponds

The technology of fish pond construction for raising striped bass is similar to what is being used in the catfish industry. There are two major costs in pond construction, earthmoving and the costs of wells and pipes. Both these costs are site specific. The earthmoving costs will depend on the topography under consideration and the size and layout of the ponds. Well costs will depend on the pond acreage, and the characteristics of the local aquifer.

To obtain an idea of what pond construction costs would be like in Maryland, the construction of a 25-acre aquaculture operation was simulated. This allowed 20 acres of water, which was separated into two 2.5-acre ponds for growth from Phase I fingerlings (2- to 4-inch fish) to Phase II fingerlings (6- to 8-inch fish). After 1 year of growth, the Phase II fingerlings were transplanted to two 7.5-acre ponds.

An approximation of the amount of earthmoving required was obtained by assuming the only earth that had to be moved was used in building pond levees. Total cubic yards were calculated by taking the average cross-sectional area of the pond levees multiplied by the total linear feet of the levees. Actual estimates of required earthmoving can be obtained only after a survey of the land under consideration. The cost of earthmoving in Maryland has been quoted to be as high as $2.50 per cubic yard. Assuming a price of $2.00 per cubic yard, the annualized cost of pond construction per pound of fish grown was $0.20. In North Carolina earthmoving prices have been quoted to be as low as $0.80 a cubic yard and as low as $0.60 in the Mississippi delta region. These lower earthmoving costs give these regions a $0.10 to $0.11 per pound advantage in production costs over Maryland. The advantage is even greater when the effect on maintenance and interest costs is factored in.

The major fixed cost by far, however, is the salary paid to a pond manager—$20,000. The individual would have to have specialized aquaculture training. This contributed $0.51 to the cost per pound of producing striped bass. Considerable savings could be achieved by not hiring a pond manager, but at a much greater risk to successful production of fish.

The major variable costs for pond operation are the purchase of fingerlings, feed costs, electricity and hired labor. The total variable costs for this hypothetical operation came to $1.43 per pound. Adding the fixed costs to the $1.43 yielded a break-even price of $2.88 per pound (Table 1). Additional harvesting and marketing costs could make the cost of delivering fresh striped bass in Maryland over $3.00 per pound. It is unlikely at current prices that such an operation would be profitable. However, if a Maryland farmer can save on earthmoving costs because he or she has his or her own earthmoving equipment, has an inexpensive supply of good quality water, and does most of the pond management, costs could be reduced considerably, perhaps as low as $2.00 per pound.

These figures were based on very conservative survival rates, feed conversion rates, and fish growth rates. A similar study for North Carolina-raised striped bass used more optimistic assumptions for each of these factors. Based on these more optimistic assumptions, striped bass could be raised in North Carolina farm ponds for under $2.00 per pound, and probably would be profitable (Table 2). Whether or not the assumptions

about fish growth, feed conversion and fish survival are valid in North Carolina or Maryland remains to be proven.

Cage and Net-Pen Culture

In ponds of sufficient size and depth, it may be possible to raise striped bass in cages or net pens. These require a much smaller investment than constructing farm ponds. A cage of dimensions 4 feet by 4 feet by 4 feet can be constructed using common materials for under $200. In this example, the costs of producing striped bass in a 5-acre farm pond were based on these home-constructed cages.

The operation is different in that Phase II fingerlings are purchased for grow-out. At the recommended stocking rates, the striped bass are raised to 1.5-pound size at a cost as low as $1.19 per pound (Table 3). The major contributors to the costs are the purchase of fingerlings and feed. There are no labor or management costs, and construction costs are considerably less than in the case of pond construction. Assuming a marketing cost of $0.25 per pound and a farm price of $2.50 per pound, the 5-acre pond could gross $5,000 and result in a profit of $500 or $50 a cage.

The pond and cages can be stocked more densely if artificial aeration is provided. There is an additional cost for purchasing the aerators, providing electric service to the pond, and the cost of electricity. These costs raise the production costs to $1.32 per pound (Table 4). However, the higher density allowed in the cages results in over $700 profit per cage. The higher density allowed

Table 1. Annual costs of hybrid striped bass production on 25 acres (20 water acres) of specially designed farm ponds (high-cost estimate)

Item	Cost	Cost/acre	Cost/pound	Percentage Fixed	Percentage Total
Fixed costs					
Land	$ 2,416	$ 97	$0.05	4	2
Construction	8,802	352	0.20	14	7
Equipment	4,325	173	0.10	7	3
Interest	19,005	760	0.42	29	15
Maintenance	7,444	298	0.17	11	6
Supervisory services	23,000	920	0.51	35	18
Total fixed costs	$64,992	$2,600	$1.45	100	51
Annual variable costs summary					
Fingerlings	$10,000	$ 400	$0.22	15	8
Feed	25,326	1,013	0.56	39	19
Electricity	10,000	400	0.22	15	8
Labor	14,352	574	0.32	22	11
Chemicals	500	20	0.01	1	0
Fuel	500	20	0.01	1	0
Interest	4,247	170	0.09	7	3
Total variable costs	$64,925	$2,597	$1.43	100	49
Total production costs	$129,917	$5,197	$2.88		

in the pond means more cages per pond—10 cages without aeration, 17 cages with—and thus, a higher net return of $12,000 for the 5-acre pond.

The farm price of $2.50 was chosen arbitrarily. Obviously, a lower farm price per pound would lower the profitability of all the technologies discussed. The likelihood of different farm prices is discussed next.

The Market for Hybrid Striped Bass

Since the commercial production of hybrid striped bass is in its infancy and no legal market exists in Maryland for hybrids, it is difficult to assess precisely what price hybrids would command if production occurred. However, analogies between the market for this product and similar products can be drawn. Looking at the historical markets for the wild striped bass *(Morone saxitilius)*, the conclusions are likely to be outdated. Therefore, examining recent prices received by culturists and watermen and considering the market for imported salmon may be more useful.

Past Experience

Yamashita (1981) and Adriance (1982) studied both the marketing practices of striped bass agents and price determination in the wholesale and ex-vessel markets. Yamashita, studying the 1972 to 1978 period, found New York City's Fulton Market to be an important element in the marketing of hybrid striped bass. She found that much of the reported Chesapeake landings are mar-

Table 2. Annual costs of hybrid striped bass production on 25 acres (20 water acres) of specially designed farm ponds (low-cost estimate)

Item	Cost	Cost/acre	Cost/pound	Percentage Fixed	Percentage Total
Fixed costs					
Land	$ 2,416	$ 97	$0.04	4	2
Construction	5,916	237	0.10	11	5
Equipment	4,325	173	0.07	8	4
Interest	13,434	537	0.22	25	11
Maintenance	5,712	228	0.09	10	5
Supervisory services	23,000	920	0.38	42	19
Total fixed costs	$54,803	$2,192	$0.90	100	46
Annual variable costs summary					
Fingerlings	$10,000	$ 400	$0.17	16	8
Feed	24,410	976	0.40	38	21
Electricity	10,000	400	0.17	16	8
Labor	14,352	574	0.24	22	12
Chemicals	500	20	0.01	1	0
Fuel	500	20	0.01	1	0
Interest	4,183	167	0.07	7	4
Total variable costs	$63,945	$2,557	$1.07	101	53
Total production costs	$118,748	$4,749	$1.97		

Table 3. Annual summary of production costs for a cage operation raising hybrid striped bass in a 5-acre pond without aeration

Item	Annual cost	Cost per pound
Cages	$ 433	$0.09
Fingerlings	2,489	0.52
Food	2,048	0.43
Maintenance	65	0.01
Interest	660	0.14
Total	$5,695	$1.19

keted there, especially in the months of April, May and June. Fifty percent of the Chesapeake wholesalers reported using Fulton prices to establish the prices they paid fishermen. All of them also differentiated their prices based on the size of the striped bass. Yamashita's analysis of prices by size suggested that sometimes small fish command a premium and sometimes it is large fish that wholesalers want. The supply of various sizes is as important as demand in determining the size premium.

Adriance (1982) and Norton et al (1983), provide a statistical model of price determination in the Atlantic Coast striped bass industry for the period 1976 to 1979. Both Fulton and Baltimore wholesale market prices responded similarly to quantities flowing into them, dropping by approximately 4.8 cents for each 10,000 pounds brought into the market during a month.[1] The Fulton price was then used to predict ex-vessel prices in the region. The ex-vessel price is an indicator of what the farmers would receive at the farm gate. Generally, northern ex-vessel prices were determined by $0.58 plus around 40 percent of the Fulton price. Southern ex-vessel prices were around $0.16 plus 50 percent of the Fulton price. The percentage change in consumption for a percentage change in price at mean prices and quantities in Fulton was −1.7 and in Baltimore −4.2. This suggests that consumers are more resistant to price increases in Baltimore than in New York. New York's large population is likely the cause of this. The New York market generally commanded a higher price, by about $1.10 per pound.

Figure 1 is an illustration of how the New York premium influences prices down the coast. New York prices were higher than the other prices, in one case by nearly 100 percent. As one moves south, the prices paid fall. An exception to this is in Maryland and Virginia. Occasionally, supply in Maryland is so much greater than Virginia that Virginia prices will be higher.

The numbers also illustrate the growth in ex-vessel prices from 1980 to 1984. Ex-vessel prices rose by nearly 40 percent. To date, no one has examined how

[1] All dollar values are presented in 1988 dollars. These are often converted from values in the 1970's using the consumer price index.

Table 4. Annual summary of production costs for a cage operation raising hybrid striped bass in a 5-acre pond with aeration

Item	Annual cost	Cost per pound	
Cages	737	$0.06	
Fingerlings	6,770	0.52	
Food	5,571	0.43	
Aerators	900	0.07	
Electric service	450	0.03	
Electric usage	1,000	0.08	
Maintenance	436	0.03	
Interest	1,256	0.10	
Total	$17,120	$1.32	
Marketing cost		$0.25	
Farm price		$2.50	$ 32,640
			−20,383
Net returns			$ 12,257
			721 per cage

much of this resulted from decreasing landings of striped bass or increasing preferences in the Northeast for fish. A portion may have resulted from the latter. Striped bass production actually rose by 25 percent between 1982 and 1984.

The prices of striped bass at various market levels can be examined to appreciate the effect of marketing on ex-vessel prices. In Figure 2, the May 1979 prices of striped bass at the retail level (in Baltimore), the wholesale level (in Baltimore), and the ex-vessel level (in Maryland) are shown. The fishermen normally sell in-the-round, a whole fish, whereas retail sales are often in the form of fillets (40 percent of round weight) or scaled/headed/gutted (80 percent of round weight).

To examine the relationship among Baltimore retail prices, Baltimore wholesale prices and Maryland ex-vessel prices, a set of regressions was run. The first related wholesale prices to ex-vessel prices and the second related wholesale prices to retail prices. The results were:

$$P_{retail} = \frac{\$50/lb}{(2.37)} + \frac{1.53}{(12.19)} \times P_{wholesale} \quad r^2 = .61$$

$$P_{wholesale} = \frac{\$0.43/lb}{(4.70)} = \frac{1.02}{(\$13.40)} \times P_{ex\text{-}vessel} \quad r^2 = .66$$

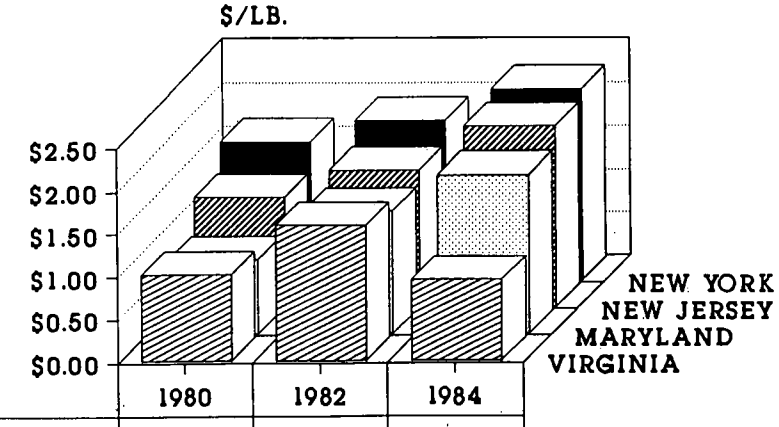
Thus, for a given ex-vessel price of $1.50 per pound in 1988, wholesale prices would be predicted to be $1.96 per pound and retail prices $3.50 per pound. On the other hand, if ex-vessel prices were $2.50 per pound, wholesale prices would be $2.98 per pound, and retail prices would be $5.06 per pound.

Unfortunately, the scarcity of striped bass, the subsequent prohibition of striped bass sales in Maryland and New Jersey, and changes in the statistical sampling of the National Marine Fisheries Service make similar current information unavailable. Only the historical analysis in conjunction with statistics about other species and anecdotes about striped bass production give insights into the current market.

Expectations

Easley (1987) suggests a wide variety of prices for stripers during the 1986 to 1987 period. Small lots of whole hybrids in California sell for $4 per pound. Larger lots receive $2.50 to $2.80 per pound. In late 1986, hybrids cultured in South Carolina were sold to wholesalers in the New York area for $3.30 per pound. In North Carolina ex-vessel prices for striped bass were around $1 per pound for wild striped bass and nearly $2 per pound for cultured striped bass. In a most recent transaction, researchers at Virginia Polytechnic Institute sold hybrids for approximately $1.25 per pound. In 1986 and 1987 Virginia watermen received around $1.20 per pound for captured striped bass. This variation raises the following question: Will prices fall sub-

FIGURE 1:
EX-VESSEL PRICES BY STATE AND YEAR



	1980	1982	1984
NEW YORK	$1.62	$1.86	$2.22
NEW JERSEY	$1.29	$1.60	$2.10
MARYLAND	$0.87	$1.44	$1.86
VIRGINIA	$1.01	$1.59	$0.95
NORTH CAROLINA	$0.92	$1.57	$0.88

stantially as production rises to any degree? The estimates of the Baltimore and Fulton markets suggested about a drop of $0.05 per 10,000-pound increase in monthly sales. One must remember the production is from a capture fishery in which production cannot be guaranteed. A cultured product should be produced more steadily and receive a premium for that consistency. Looking at another cultured product to observe price elasticity will be helpful.

Salmon is the "Cadillac" of fin fish and has been cultured in Norway, Scotland and many other places in the world. Its production can be guaranteed and, because of that, providers in those countries probably receive a premium over salmon produced in the wild. Restauranteurs, for example, prefer having salmon on a consistent basis rather than as a seasonal item. In 1986, the price of imported salmon in New York's Fulton market was $4.35 per pound in April for a 7-to 9-pound fish. By April of 1987, the price had risen to $4.65 and continued to rise to $5.60 as of June 1987. The most current wholesale prices show the 7-to 9-pound salmon commanding $5.00 per pound. Prices have remained high despite increasing imports. In fact, imports of salmon have doubled since 1984, from 21 million pounds in 1984 to 42 million pounds in 1987.

This historical record suggests several things about the potential market for cultured striped bass. Providers can expect

- a range of expected wholesale prices from $1.50 per pound to $3.50 per pound,
- an expected farm price in the range of $3 per pound to $1 per pound, and
- a market that currently depends on landings of wild striped bass but may eliminate that dependency.

Discussion

Returns to Hybrid Striped Bass Aquaculture in Maryland

The analysis of production costs and product prices leads to some simple comparisons. The return to management for different scale operations and different product prices is shown in Table 5. Low prices ($1.50 per pound) make large-scale striped bass production, both with optimistic and pessimistic projections, unprofitable in Maryland. They also make the small-scale operation with aeration unprofitable. At $2 per pound, the small-scale cage culture is profitable but the large-scale operations are still unprofitable. At $2.50 per pound, the large-scale operation is profitable for optimistic cost estimates but not for pessimistic ones. The numbers also suggest that the pen or cage culture with aeration is the most profitable operation for prices from $1.50 to $2.50 per pound. The profits range from a high of $2,451 per pond acre to $1,145 per pond acre.

FIGURE 2:
PRICES IN DIFFERENT MARKETS-MAY 1979

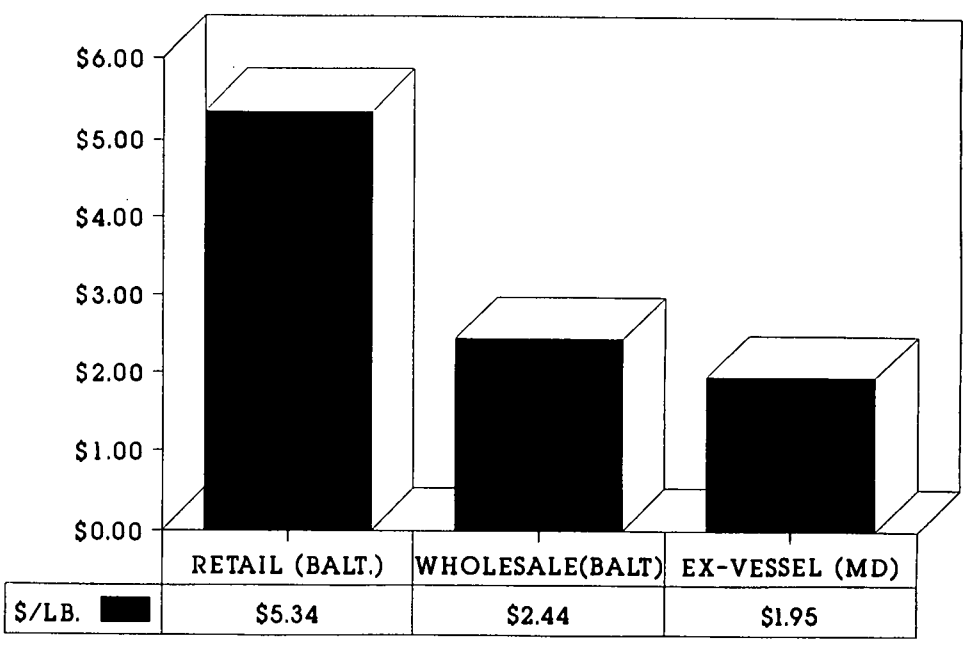


Table 5. Returns to management by technology and market price

	Returns to management			
	Large scale		Small scale (cages)	
Price	High cost	Low cost	Without aeration	With aeration
$2.50	Loss	$700/acre	$1,021/acre	$2,451/acre
$2.00	Loss	Loss	$541/acre	$1,145/acre
$1.50	Loss	Loss	$61/acre	Loss

On the more negative side, the returns to constructed ponds are mostly in the red. The only profit, $0.29 per pound, is obtained with a $2.50 per pound price. The primary cost is the supervision of the ponds, largely a fixed cost. The costs of operating a constructed pond might be reduced by expanding the pond acreage. The limits on supervisory capacity are not known. The other potential problem with pond construction in Maryland involves the substantially lower construction costs and opportunity costs of land in more southern states. Catfish producers, for example, are beginning to show interest in hybrid striped bass production (R. Harrell, personal communication).

The Future

Perhaps the most binding constraint on hybrid striped bass aquaculture is the fact that there are numerous laws governing the harvest and marketing of striped bass. These laws are established to conserve the natural stocks but also affect the potential harvest from aquaculture. Thus, if a state has a 33-inch size limit on the capture of striped bass, then the law will likely imply that to be harvested a hybrid striped bass must be larger than 33 inches. The rationale is largely an enforcement argument—managers argue the hybrid is not differentiable from a natural striped bass.

The force of the rationale depends on with whom one discusses these issues. Many who are pro-aquaculture state that there are at least two distinguishing features: the size and shape of the head, and the broken lateral stripe on the hybrid. No one to date has tested the distinguishability, although some research is in progress. If the distinction could be made by a genetic change (through biotechnology) or the law changed, there is a strong potential for small-scale operations in Maryland. An estimated 10,000 existing ponds in Maryland could produce 7.5 million pounds of hybrid striped bass (assuming the average pond size was 1 acre and 50 percent of the harvest was used). At a $2 per pound farm price, this would yield a retail value of $22.6 million. If the hybrid striped bass were produced with aerated cage cultures, it could mean an infusion of $6 million into farm profits. As time elapses and demand increases, larger scale operations would likely be profitable.

At present aquaculture production in Maryland resembles a wild striped bass fighting to get upstream. There are a number of obstacles in the way but the incentive to overcome them is there.

Acknowledgments

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Agriculture and the Environment

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Introduction

Productivity and economic viability in modern American agriculture have become dependent on five conditions and practices that maximize yields at minimum costs: (1) favorable soil resources; (2) crop varieties that produce high yields under conditions of good fertility and nutrient availability; (3) large, powerful and sophisticated equipment for most agricultural operations; (4) use of relatively inexpensive commercial fertilizers to meet crop nutrient requirements; and (5) use of pesticides that minimize the need for repeated cultivation and labor. These factors illustrate the major trends that have contributed to the mechanization and intensification of agriculture in this country.

A major underlying force driving these trends in agricultural production is the need to reduce labor costs. It has become evident that the resulting highly intensified farming systems have side effects that can adversely impact the surrounding environment, as well as the farm operation itself.

Conservation of soil and water resources has been an issue in agriculture since the dust bowl days of the 1930's. Historically, efforts have focused on controlling soil erosion and ensuring adequate supplies of high quality water to maintain the productivity of the nation's farmland. These issues are still here today, but they have been somewhat overshadowed by a growing recognition that traditional and widely accepted agricultural activities can have adverse effects on the environment. Parties both inside and outside of the agricultural sector are particularly concerned because these problems have not arisen as a result of illegal practices, but occur as a result of accepted and encouraged agricultural production activities.

Sediment and nutrients have been identified as major factors in the decline of the Chesapeake Bay and its tributaries. In addition to surface water problems, there is a growing concern both in Maryland and throughout the nation about the quality and quantity of ground water resources. Competing demands have seriously depleted principal aquifers; leaks from underground storage tanks, disposal of wastes, and the use of pesticides and fertilizers threaten ground water quality in many areas.

This paper will explore the impacts of agricultural nonpoint source pollutants, namely sediment, nutrients and pesticides, on surface and ground water resources. Agricultural nonpoint source pollutants can reach surface water through runoff and subsurface discharge from fields and pastures where animals are concentrated. Soluble substances can pollute ground water by leaching through the soil profile to the water table. The place-to-place and year-to-year variability of such factors as climate, soil and watershed characteristics, production practices, chemical interactions, hydrology, geology and land use all complicate the process of adequately managing land activities to minimize nonpoint source pollution.

The Impact of Nonpoint Source Pollutants

Sediment

Eroded soil entering waterways in runoff has been long recognized as a source of environmental pollution, largely because this process and its effects are relatively

direct and obvious. Sedimentation may come from eroding cropland, construction sites, logging operations and other activities that expose the soil to rainfall and allow soil to move with the surface runoff.

While the proportion of cropland suffering from severe erosion has decreased in the past decade, erosion and sedimentation are serious problems in the United States. In the Northeast, the average annual rate of soil loss is 4.8 tons per acre per year. Sixty percent of the cropland in the Northeast has a very acceptable erosion rate of less than 2 tons per acre per year. Unfortunately, 15 percent of the cropland in the Northeast is eroding at annual rates over 8 tons per acre per year.

"Sediment and nutrients have been identified as major factors in the decline of the Chesapeake Bay and its tributaries."

In Maryland the average annual soil loss from cropland is 5.2 tons per acre per year. When considering all land use classes in Maryland, 1,125,000 acres are considered adequately protected with erosion rates at or below acceptable levels. However, 327,000 acres are believed to be eroding at over two times the acceptable rate (Minnich, personal communication). Currently within Maryland, 795,600 acres of cropland, approximately 34 percent of all farmland in the state, are adequately protected from erosion. However, erosion control Best Management Practices (BMP's) are lacking on approximately 808,400 acres of cropland. Some acres may however be counted more than once since multiple BMP's will be required on some acreage to adequately protect the soils from erosion.

What are the implications if cropland is allowed to continue to erode at unacceptable rates? The consequences include both onfarm and offsite effects. Continual erosion above acceptable values will decrease the long-term productivity of the soil resource. Estimates made during the development of the Resource Conservation Act show yield decreases of 8 percent could be expected within 50 years. A University of Minnesota study predicts a decrease in yield of 5 to 10 percent in less than 100 years; studies at Resources for the Future indicate a reduction in yield of 3 to 5 percent over a 30-year period (Crosson and Stout 1983). Crosson (1984) estimated productivity losses resulting from continued soil erosion could reach $4 billion to $17 billion over the next 100-year period. These estimates do not include the cost of increased fertilization and other farm inputs necessary to compensate for lowered productivity or the costs of conservation control practices to reduce erosion and nonpoint source pollution. Recognition of these expenses suggests that the costs of soil loss to society will be considerably higher than indicated by these estimates.

Continuing erosion not only depletes the productivity of the soil, but as the soil moves off the fields, soluble and adsorbed nutrients and pesticides can move off the farm and into water bodies. Approximately one-third of all sediment loads can be attributed to soil loss from cropland. Sediment deposits in streams and other water bodies cause problems with navigation, degrade water storage facilities, clog drainage ditches, and impair the quality of water-based recreation facilities. A Conservation Foundation study (Crosson 1984) estimated these costs to be from $2 billion to $6 billion per year. Crowder et al. (1988) estimate that costs associated with offsite damages resulting from sediment pollution amount to $5 billion to $15 billion annually in the United States. In addition sediment can seriously inhibit the growth of submerged aquatic vegetation and destroy or severely damage habitats for other aquatic organisms.

These costs and those associated with losses of onfarm productivity, can be addressed through BMP's. Erosion control on cropland includes traditional soil conservation practices such as conservation tillage, contour and strip cropping, terrace and diversion systems, grass waterways, cover crops, filter strips and crop rotations. New programs under the 1985 Food Security Act provide incentives for implementing these practices. For the 278,613 acres of highly erodible land in Maryland requiring soil and water conservation plans to be eligible for government programs under the Food Security Act, the Soil Conservation Service has completed plans for over 220,000 acres. However, the extent to which these plans have been implemented is not known. The Conservation Reserve Program (CRP), which removes highly erodible lands from production and places them under conditions of more permanent vegetation, also has the potential to greatly reduce soil losses from particularly vulnerable acreage. In Maryland, however, the effort to bring these lands into the CRP has had limited success, with less than 20 percent of the eligible land being enrolled.

Nutrients

Soil loss from cropland is also a significant factor in nutrient export from agricultural land and subsequent enrichment impacts on the Bay and its tributaries. However, the practices necessary to adequately control

nutrient export from the land to the water go beyond those traditionally associated with erosion control.

Movement of nutrients from agricultural lands into both surface and ground waters is a problem in Maryland. Nutrients leave fields and reach surface water bodies either attached to sediment and organic matter or dissolved in runoff and subsurface water. Soluble nutrients can move to ground water by leaching through the soil profile.

Surface Water. Nitrogen and phosphorus are common pollutants of surface water resources. This enrichment has a variety of direct and indirect impacts. Excessive production of algae and epiphytic growth interfere with light penetration and contribute to low oxygen levels and alterations in food and resource availability to higher organisms such as aquatic plants, fish, oysters, and migratory waterfowl. The impacts of nutrient enrichment of the Chesapeake Bay have provided a major impetus for improved management and control of point and nonpoint sources. Maryland, together with the states of Virginia and Pennsylvania, the District of Columbia, and the U.S. Environmental Protection Agency, has recently made an unprecedented commitment to this end as part of the 1987 Chesapeake Bay Agreement.

Figures 1 and 2 present recent estimates made by the Maryland Department of the Environment (1988) of nitrogen and phosphorus contributions to the Chesapeake Estuary from sources in Maryland. Point and nonpoint sources contribute approximately equal loads of both nutrients. Agricultural sources are estimated to contribute about two-thirds of the total nonpoint source nitrogen load, and three-quarters of the nonpoint source phosphorus load.

A breakdown of Maryland nonpoint source loads attributable to human activities is presented in Table 1. Cropland is the largest contributor of both nitrogen and phosphorus. Development and agricultural animal wastes are estimated to contribute similar nitrogen loads, while phosphorus loads from development are almost twice those estimated for animal wastes.

Examined on a finer geographic basis, nonpoint source nutrient enrichment is a problem throughout many of the river systems in Maryland (Tassone and Shanks 1988). For some, such as the Choptank River on the Eastern Shore, nutrient inputs are dominated by agricultural sources. In contrast, the West Chesapeake area on Maryland's Western Shore, point source loads exceed nonpoint source inputs. Agriculture is still the principal nonpoint source contributor, but a much larger

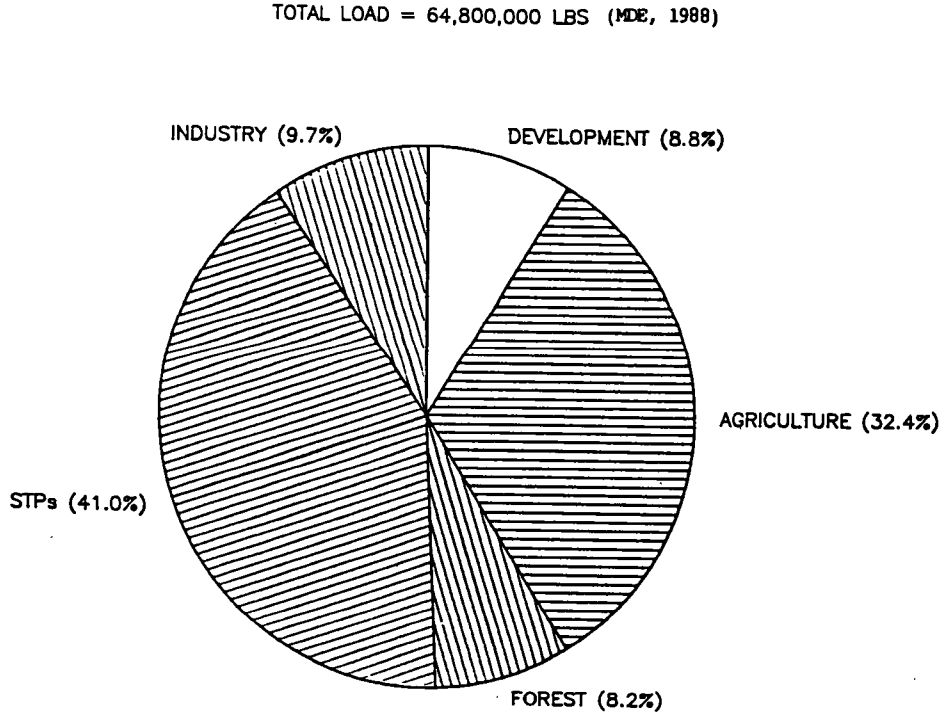

Figure 1. Nitrogen loadings to the Chesapeake Bay from Maryland sources in 1985.

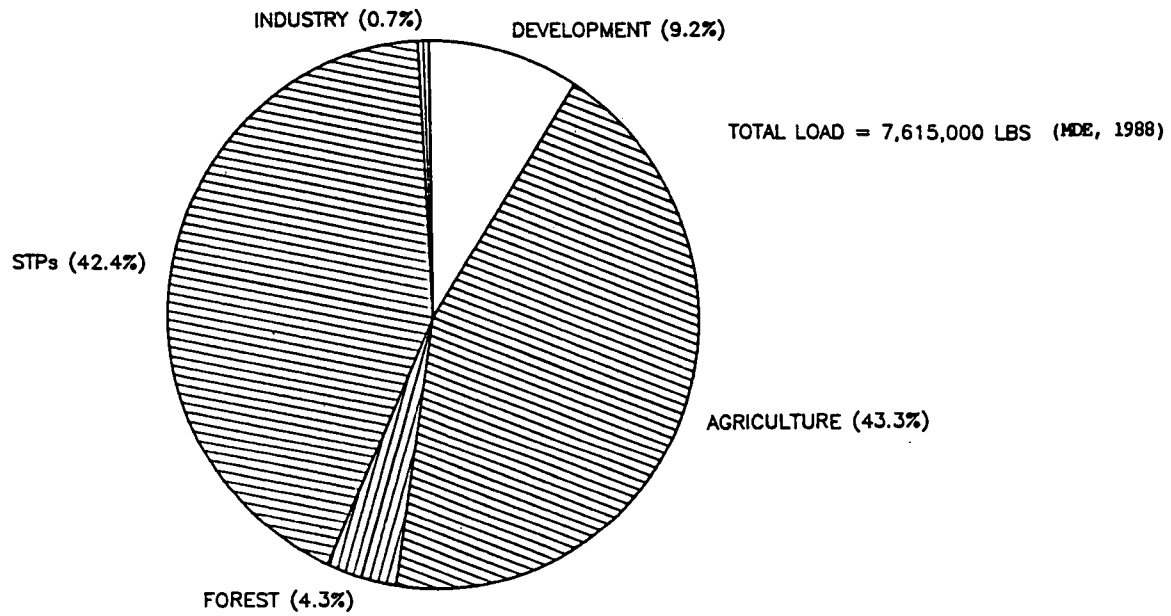

Figure 2. Phosphorus loadings to the Chesapeake Bay from Maryland sources in 1985.

proportion of nonpoint source loads comes from development in this area than in the state as a whole. New development is projected as the nonpoint source with the greatest potential for increased nutrient loads in the future. Thus, while the need to reduce pollution from agricultural nonpoint sources is clear, the need for better control over nutrient pollution from new development is also essential.

The conservation practices that have been emphasized up to the present for Maryland cropland are effective for the control of sediment and in reducing potential phosphorus losses. Conservation practices directed at controlling soil loss are not effective, however, for the reduction of nitrogen to subsurface water or for losses of soluble phosphorus in surface water. Practices currently used to control animal waste originating from concentrated production facilities have emphasized management by proper containment and storage. This is necessary for controlling manure nutrients, but must be supplemented with proper application practices.

To address these limitations, new initiatives must be implemented to encourage the widespread use of farm-specific nutrient management plans, and to establish forested buffer strips along stream channels adjoining cropland. Nutrient management will facilitate the proper use of animal wastes, commercial fertilizers and sewage sludge, while taking into account cover crops and legumes. Along with stressing the use of appropriate rates of fertilization, this program will also recommend appropriate timing and methods of applying nutrients from various sources. Nutrient management plans are expected to reduce significantly nutrient losses to waterways. Forest strips result in lower direct nutrient yields to streams than other land uses. Under appropriate hydrogeologic conditions forest buffer strips can retain large quantities of nutrients and sediment from upland sources.

In addition to farm nutrient management and forest buffer strip establishment, more effort must be placed on effective targeting of the various control techniques within the context of soil conservation and water quality management plans; providing appropriate incentives to implement management plans; and improving coordination among the agencies through which the agricultural nutrient loads must be managed. During the next several years, the effectiveness of Maryland's present voluntary approach to controlling nutrients from agricultural sources will be examined in order to modify incentives as needed to achieve the water quality goals of the 1987 Bay Agreement.

Ground Water. Nitrogen, in the form of highly soluble nitrate, is the nutrient of most concern. High concentrations of nitrates in ground water can have health effects on humans, particularly infants, and on livestock. Nitrates also can contribute to enrichment of surface waters.

A major area of concern in Maryland is the widespread increased nitrate levels in the Columbia Aquifer under-

Table 1. Nonpoint source nutrient loads to the Chesapeake Bay caused by human activities in Maryland

	Development		Cropland	Pasture	Animal Waste
	Low/Moderate Density	More Intense			
Nitrogen					
Amount (million lb/yr)	3.24	2.43	16.99	0.81	3.13
Percentage (of total NPS N load)	11.0	10.4	61.0	2.0	15.6
Phosphorus					
Amount (million lb/yr)	0.42	0.29	2.95	0.12	0.22
Percentage (of total NPS P load)	9.5	6.7	68.1	2.9	5.1
Estimated area for each source (thousand acres)	532.0	174.5	2,270.0	180.7	1,250.0

Source: Tassone and Shanks 1988.

lying the Delmarva Peninsula. The Columbia, a surficial and largely unconfined aquifer, is a major source of local water in the central portion of the peninsula. Recently, many wells in the Columbia have been abandoned and replaced with deeper wells as a result of nitrate problems. Elevated levels of nitrate in the Columbia result from human activities. The major nitrogen sources include cropland, onsite sewage disposal systems, land-applied wastewaters from municipal and industrial treatment processes, and concentrations of animal wastes.

A study of the nitrate-nitrogen levels by the U.S. Geological Survey (USGS) (Bachman 1984) found significant levels in many wells in the Columbia Aquifer. Fifty-two percent of the 509 samples analyzed exceeded 3 milligrams NO_3-N/l. The levels are considerably greater than naturally occurring concentrations. EPA's water quality standard of 10 milligrams was exceeded in 15 percent of the samples. In general, concentrations tended to be higher in shallower wells, but high concentrations were found in some deeper wells. Land use was significantly correlated with nitrate levels in sampled wells. The highest median concentrations occurred in wells near poultry houses (10 milligrams per liter); followed by cropland (5 milligrams per liter); urban areas (2.5 milligrams per liter); wooded areas with residences (1.5 milligrams per liter); and undeveloped woods and wetlands (less than 1 milligram per liter). Cropland areas with residences (and presumably onsite sewage disposal) had higher levels than cropland without residences. The same was true for wooded areas with and without residences. Despite having the lowest median values, nitrate levels associated with wooded and wetland areas were higher than expected "natural background" levels (.2 to .42 milligrams per liter).

Other studies on the Delmarva peninsula have shown elevated levels of nitrates under cropland. Monitoring wells located on a farm in Queen Anne's County have often shown concentrations above the 10 milligrams per liter limit. Similar data have been collected under both nonirrigated and irrigated cropland in Caroline and Dorchester counties. These elevated nitrate levels are consistent with data from other states, illustrating the degradation of ground water resources from row-crop production.

Nitrate concentrations observed in the USGS study were highest in the Choptank River basin and the northern portions of the Nanticoke River basin. The median concentrations of samples from Caroline, eastern Talbot, and northern Dorchester counties within those two basins averaged approximately 5.4 milligrams per liter. Concentrations less than 1 milligram per liter were found generally in Wicomico and northern Worcester counties. This region consists of large areas of poorly drained soils conducive to denitrification of nitrates, reducing conditions within the aquifer, and enhances dilution in the larger, deeper flow systems in the area.

These findings, when considered in relation to information compiled on surface water quality in the Chop-

tank River Basin, indicate a strong potential for enriched ground water to influence surface water quality. Nitrogen levels in the Choptank system have increased in recent decades (Maryland Office of Environmental Programs Report 1987), and nonpoint sources dominate the nitrogen inputs to the estuary (Tassone 1987). Findings of Fisher (1987) indicate that instream nitrate concentrations in the Upper Choptank decrease during runoff events, suggesting a dilution effect of surface runoff on base flow. If the finding that an average 5 milligram NO_3-N/l nitrate in ground water (USGS study) is representative of the Choptank area, there is clearly a potential for the aquifer to deliver a concentrated nitrogen load to surface water in base flow.

"Continuing erosion not only depletes the productivity of the soil, but as the soil moves off the fields, soluble and adsorbed nutrients and pesticides can move off the farm and into water bodies."

Combatting ground water enrichment requires intensive nutrient management with the adoption of management practices where nutrients are applied at appropriate rates and times to optimize crop utilization and minimize losses to surface and ground waters. Use of recommended methods of application and cropping practices designed to minimize nutrient losses will further reduce the potential for water pollution from highly soluble nutrients. As discussed previously, soil conservation practices alone do not prevent dissolved nutrients from leaving the field or from leaching to ground water. The integration of traditional soil conservation BMP's with nutrient management should facilitate protection of both surface and ground water resources.

Pesticides

Pesticides have been used in modern agriculture to benefit both the producer and the consumer. Insecticides have made possible increased yields and quality of fruit, vegetable and grain crops. Herbicides have allowed the widespread adoption of no-tillage and conservation tillage practices, which greatly aid the soil conservation and water quality efforts. The use of pesticides has allowed the American farmer to increase production at a reasonable and affordable price. The agricultural sector is the largest user of pesticides, accounting for approximately 60 percent of all material sold. With the exception of accidental spills, immediate detrimental effects of pesticide contamination of water bodies are rarely seen. However, the environmental issues relating to agricultural uses of pesticides are numerous and varied.

Pesticides have been discovered in surface and ground water resources in several states. Potential environmental impacts can be grouped into three main categories: effects relating to human health, effects on resource availability, and impacts on non-target organisms.

By 1986, 19 different pesticides had been detected in ground water in 24 states, in each case most probably resulting from an agricultural application, (U.S. Environmental Protection Agency 1987). Not all pesticides have the same potential to contaminate water resources. This depends on four attributes of a pesticide: its rate of decomposition by sunlight, water and microorganisms; its volatility; its tendency to adhere to soil particles and organic materials; and its mobility in soils and water. The particular combination of these attributes for a given pesticide, as well as topography, soil characteristics, application procedures and rainfall will determine its potential to contaminate ground or surface water.

Maryland's Situation. Some information on pesticides detected in Maryland ground or surface water and information on Health Advisory Levels (HAL's) and Maximum Contaminant Levels (MCL's) established by EPA is presented in Table 2. HAL's are estimations of the levels in drinking water considered safe for people. The HAL's listed are those estimated for lifetime consumption periods, with the exceptions of alachlor, 1,2-dibromo-3-chloropropane (DBCP), and 1,2-dichloropropane (DD). These pesticides are known or suspected carcinogens, and the HAL's for them represent concentrations related to cancer risk. MCL's are also concentrations, but differ from HAL's in that they are the enforceable water quality standards for toxic chemicals in water from public systems.

Within Maryland, alachlor, atrazine, carbofuran, DBCP, DD and simazine have been detected in ground water. Atrazine, simazine, alachlor and linuron also have been found in the surface waters of the state. Concentrations in surface waters are generally highest in the fluvial waters nearest the point of application and lowest in estuarine waters.

Five of the pesticides detected to date in Maryland waters are among the seven most heavily used agricultural pesticides in the state, based on estimates of 1985 usage (Maryland Department of Agriculture 1986). Most of these compounds were used in all of the physio-

Table 2. Concentrations of some pesticides found in Maryland ground and surface waters

Pesticide	Rank[1]	Concentrations Found in		EPA Health Advisory Level	EPA Proposed Maximum Contaminant Level
		Ground Water	Surface Water		
		parts per billion			
Alachlor	3	0.1–0.8[2]	3.0[3]	44	2
Atrazine	2	0.4–0.9[2]	3.5–9.0[4]	3	2
Carbofuran	4	1–50	—	36	40
DBCP[6]		0.02–20[5]	—	2.5	0.2
DD[6]		1–50[5]	—	20–56	5
Simazine	5	0.1–3.0[5]	—	35	—
Linuron	7	—	1.2–3.0[4,5]	—	—
Triazines		—	0.6–1.7[7]	—	—

Notes:

[1] Rank in terms of amount of active ingedient used in Maryland in 1985 (from MDA 1986).

[2] In wells in Carroll, Caroline, Wicomico, Dorchester and Washington counties (MDE Report 1987).

[3] Peak concentrations in Rhode River (Kemp et al. 1981).

[4] Peak concentrations in Choptank River mainstream (Kemp et al. 1981).

[5] National range of U.S. Environmental Protection Agency data which includes unidentified Maryland observations.

[6] Registration cancelled.

[7] Treated tapwater from Rockville, Potomac, Patuxent and Baltimore filtration plants 1982 to 1983 (Glotfelty et al. 1986).

graphic provinces of Maryland, with the majority of use occurring in the Coastal Plain, followed by the Piedmont. Carbofuran, a combination soil and systemic insecticide/nematicide commonly used on corn and tobacco, is one of the most heavily used pesticides in Maryland (Maryland Department of Agriculture 1986).

The herbicides atrazine and linuron are used principally on corn and soybeans, and rank second and seventh respectively, among pesticides used in Maryland during 1985 (Maryland Department of Agriculture 1986). Kemp et al. (1981) examined the potential effects of herbicides, specifically atrazine and linuron, on submerged aquatic vegetation (SAV) in the Chesapeake Bay. Concentrations of pesticide parent compounds in the estuary did not cause long-term accumulation in the water column or in sediments. Based on these findings, these pesticides can be ascribed only a minor contributing role in the decline of SAV in the Bay.

Table 2 includes ranges for atrazine, carbofuran, DBCP, DD and simazine taken from EPA's Proposed Pesticide Strategy (U.S. Environmental Protection Agency 1987). These ranges include data from Maryland, but are representative of other states as well. For carbofuran, DBCP, and DD, these are the only data representing ground water concentrations in Maryland. Original sources were not identified, so the position of Maryland data within the range given cannot be discerned.

The last entry in the table presents the range of mean monthly triazine levels found in treated tap water from several filtration plants supplying public water in the Baltimore-Washington areas. Contamination was found throughout the year (in every sample and month) in all five of the water supply facilities tested, which take their water from the Gunpowder (Loch Raven Reservoir), Patapsco (Liberty Reservoir), Potomac and Patuxent river systems.

Comprehensive information on pesticides in Maryland ground water is not currently available, and the extent of contamination problems has not been adequately assessed. The fact that pesticides have been detected in ground water from a variety of locations in the state, in the Bay mainstem, in estuarine tributary reaches, and throughout the year in treated tapwater samples originating in four different river systems, suggests that Maryland's pesticides are entering water supplies with considerable frequency. While observed concentrations are not a cause for alarm, the distribution and levels of contamination suggest that additional attention is needed if more serious contamination problems are to be prevented.

Management and Control of Pesticides. The reduction of the impact of agricultural uses of pesticides is certainly one of the most prominent public concerns about the impact of agriculture on the environment. Action to meet this concern, while recognizing the need

for continued use of these materials, must be based on a better data base of information than currently exists. State action to address the effects of pesticides in ground and surface waters should include three steps:

1. monitoring ground water, particularly in vulnerable areas, to access pesticide contamination from agricultural sources;
2. mapping ground water resources according to use, value and vulnerability to contamination for the purpose of developing protection strategies; and
3. implementing area-specific management tools, such as those listed in Table 3 to minimize environmental impacts.

One of the most promising management tools available to address pesticide use is Integrated Pest Management (IPM). The potential economic and environmental benefits of IPM are considerable. Information from a summary of IPM projects (Dively, personal communication), illustrates the benefits of IPM. During 1981 to 1985, participating small grain farmers in Maryland treated an average of 75 percent less acreage than non-IPM farmers. Alfalfa farmers used 40 to 60 percent less insecticides for the alfalfa. Corn producers used 80 percent less soil/systemic insecticides at planting and improved the timing of postemergent herbicides, resulting in a 50 percent improvement in weed control.

Documented savings from improved pesticide use and increased yields totalled $150,000 to $225,000 annually on the acreage involved (4 percent of the field crop acreage in the state). Estimated potential savings with statewide adoption of IPM could exceed $5 million annually.

Table 3. Area-specific management approaches to control of pesticide contamination

Assessement of contamination, risk and management needs based on
Use, value and vulnerability of water resource
Contamination data
Pesticide use
Management options
Local cancellations and moratorium areas
Wellhead protection, set-backs, location, depth and construction requirements
Additional monitoring
Additional education and training
Best Management Practices
Integrated Pest Mangement

Adapted from U.S Environmental Protection Agency 1987.

The trend in the "weed component" of Maryland's IPM program is towards the use of postemergent herbicides. This facilitates selection of weed-specific herbicides and optimal timing of applications. The result—better weed control, greater productivity and less reliance on the use of preemergent herbicides such as alachlor, atrazine, carbofuran and linuron, the major herbicides occurring in Maryland waters (Table 2). Expanded use of IPM approaches to weed control has considerable potential to address this problem.

Conclusion

Predicting and evaluating the full extent of water pollution or other potential problems associated with agriculture is difficult. As stated previously, the issue of nonpoint source pollution is complicated by the variability in climate, soils, watersheds, production practices, hydrology, geology and land use. Notwithstanding these complexities, the problems are real, and action must be taken to minimize future degradation of water resources. Currently, most farmers in Maryland adopt conservation and water quality practices to gain economic benefits. Some may adopt practices voluntarily out of concern for environmental quality or to reduce the threat of regulation of agriculture in the future.

Water quality protection will greatly affect the nature of agricultural production in the coming decades. Today, in several states, regulations are being developed or implemented to control agricultural nonpoint source inputs to surface and ground waters. California has approved a Safe Drinking Water and Toxic Enforcement Act, which holds individuals and organizations accountable for their use of chemicals that can cause cancer, birth defects or sterility in humans (Farrell 1987). Kansas has passed the Chemigation Safety Act to minimize pollution of ground water by agrochemicals applied through center pivot irrigation systems (Crowder et al. 1988). Iowa has enacted legislation related to water pollution from agricultural nonpoint sources. This legislation provides for the taxation of chemical and fertilizer sales to provide funding for educational programs, monitoring, research and remediation.

Federal legislation will continue to influence agricultural activities. The Clean Water Act (CWA) facilitates state efforts to protect surface and ground water resources. The 1987 amendments to the CWA contain stronger incentives on nonpoint source pollution control, requiring states to implement control programs through regulatory and voluntary mechanisms. These amendments also call for ground water protection and enforcement. The Safe Drinking Water Act (SDWA) protects potable water from nonpoint sources by establishing MCL's for a limited number of inorganic and organic compounds (such as nitrogen, pesticides and heavy

metals) in water distributed through public supply systems. However, the SDWA is expanding controls over greater numbers of agricultural chemicals and animal wastes. The Food Security Act, through the swamp buster, sod buster, conservation reserve program, and cross compliance provisions also has the potential to strongly influence agricultural production practices and water quality protection measures.

The use of IPM, conservation tillage and no-till, an increased emphasis on less toxic pesticides and the more efficient use of fertilizers and manures have all been responsible for reducing agricultural nonpoint source pollution. However, increasing attention on the protection of both surface and ground water resources could dramatically alter the production of agricultural crops. Agricultural producers may see, and in some states have already seen, taxes on agrochemicals and fertilizers, bans or restrictions on certain pesticides in specific areas, mandatory conservation and management practices, and restrictions on the use and management of land. Maryland's Critical Areas legislation currently provides certain controls in the 1,000-foot critical area along the tidal waters of the state. Widespread regulation and control of agricultural production to address environmental protection could greatly affect the distribution and economics of farming.

As Farrell (1987) states, the information needed to meet the challenge of having profitable agriculture and high quality water is enormous. Environmental risk associated with agriculture will never be reduced to zero; there will always be trade-offs between alternative agricultural strategies and environmental quality. Additional information is needed on the extent and magnitude of water quality problems, the effectiveness of management practices, and on the optimal approaches and production methods needed to resolve these problems. Research is essential to develop the techniques necessary to minimize problems in the future. The mechanisms for transferring this information to decisionmakers and to the agricultural service and regulatory sectors must be strengthened. Education of the general public is also essential, in that public opinion and attitudes can play a major role in facilitating or hindering implementation of desirable solutions.

Agricultural impacts on the environment have not resulted from intentional disregard of the environment. Instead, they appear to have resulted from accepted production practices and limited awareness of environmental effects. Other contributing factors include lack of information on alternatives, and economic pressures, which impede implementation of alternatives for some farmers. All of these deficiencies must be recognized and considered, in conjunction with alternative voluntary incentives and mandatory requirements, in the evolution of future environmental programs and constraints for Maryland agriculture. In this regard, citizens must remain sensitive to the economic pressures on agricultural producers while striving to maintain environmental quality. Agricultural producers, in turn, must remain aware of their responsibility to maintain environmental quality.

"While the need to reduce pollution from agricultural nonpoint sources is clear, the need for better control over nutrient pollution from new development is also essential."

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Potential Conflicts for Air and Water Use

William L. Magette and Herbert L. Brodie

The subject of 'Water Rights' has been a topic of considerable interest to both legislators and agricultural organizations in Maryland for a number of years. When a series of dry years affects the agricultural income of the State, attention is directed toward the greater use of surface streams and underground water for irrigation. Likewise, with the increased industrial development in the suburban counties the conflict between pollution and consumption of water attracts the public attention (Reno 1965, Forward).

Introduction

Reno (1965) offers a fitting introduction to this discussion of potential conflicts for water and air resources in Maryland. Those concerned with natural resources management wonder what environmental changes might occur as the next century approaches, knowing that the history of Maryland is closely tied to agriculture as well as to the diversity and abundance of the state's natural resources. Ever since 1631 when the first white settlers began trading agricultural and forest products, entrepreneurs have come to Maryland and benefitted from the state's favorable combination of water and soil resources and moderate climate. Maryland's proximity to major metropolitan centers in the industrialized northeast, and to the nation's capital, has further encouraged the influx of inhabitants to the state.

The coined phrase defining pollution of the Chesapeake Bay as a "people problem" vividly describes the relationship and potential conflicts between population growth, human activity and the quality and availability of natural resources. As the 21st century approaches, two trends related by a common theme—decentralization—will intensify the potential for conflict over water and air.

The first trend is decentralization of political decisions so that more and more decisions are being made at the local and regional levels. Real political power is shifting away from the U.S. Congress to states, cities, towns and neighborhoods (Naisbitt 1984). This is especially true with water and air issues. For example, individual states are developing their own ground water management strategies, at the urging of the Federal government. County governments are developing ordinances to control offensive odors from agricultural operations. These trends highlight the fact that agriculture and other facets of life increasingly will be governed by local decisionmakers.

The second trend is decentralization of populations, that is, the movement of people from urban to nonurban areas or the expansion of urbanized areas into rural areas. As Naisbitt (1984) reports, "Americans are spreading out to small towns and rural areas and leaving the old industrial cities . . ." (p. 104). This trend is particularly evident in Maryland as population statistics presented later in this paper demonstrate. Even with proper planning for development, an increasing rural population will stress the natural resources in these areas. Just as important for agriculture, this new rural public—uninformed as it is about agricultural practices, yet empowered by the trend toward localized decisionmaking—may insist that agriculturalists abide by different rules.

Another trend, not related to the decentralization issue, bears mentioning at this point—America's change from a national to a global economy. As Naisbitt (1984) points out, the United States is relinquishing its dominant position in the world's economy. Many nations now rival America's capacity to produce any number of products, including agricultural ones. Unfortunately for American agriculture, this means that U.S. farmers no longer have a monopoly on the food and fiber market.

The premise of this paper is that these trends will affect the future of Maryland agriculture. Specifically, an increasing and redistributing population may in fact cause conflicts with agriculture over both water and air resources if these resources are not managed carefully. Water and air quality issues will not be addressed.

Trends and Potential Conflicts

It is natural as civilizations mature that the proportion of residents devoted to agrarian occupations declines relative to other job markets. Mitchell and Muller (1979) point out that by 1900 the trend to industrialization was well underway in Maryland. The predominance of agriculture as an occupation has continued to decline over the last 80 years. Now, production agriculture accounts for only a small percentage of the state's gross state product (GSP) and job market (Table 1). As a percentage of Maryland's GSP, the economic value of agricultural products is outweighed by the value of services produced by government, wholesale and retail trade, community, social and personal services, finance, insurance, real estate, transportation, communication and utilities that represent 57 percent of the GSP (World Book 1986). These figures do not reflect the magnitude of GSP and job market contributions from the entire agribusiness complex that includes goods and services associated with the agricultural industry in Maryland. Nevertheless as a practical matter, these data suggest that agriculture has lost much of the economic clout that it enjoyed in the past, despite the fact that the agribusiness complex in total still represents a large portion of the services portion of the GSP.

The trends in the state's GSP are reflected by the distribution of rural, farm and urban populations and changes in land use (Table 2). Although statewide population statistics suggest a decrease in the rural population between 1970 and 1980, some traditionally rural counties have experienced tremendous population growth (Table 3). These data suggest two important trends in Maryland: (1) Maryland's population is becoming increasingly nonagricultural; and (2) agricultural production is occurring more intensively and on fewer farms. The data also indicate the conversion of agricultural land for residential land use.

Table 1. Economic activity and production in Maryland

Activity	Percentage of GSP	Percentage of Total Work Force
Services		
Government	20	22
Wholesale, retail trade	19	24
Community, social and personal services	18	23
Finance, insurance and real estate	15	6
Transportation, communication and utilities	9	5
Agricultural production	1	2
Industry		
Manufacturing	13	12
Construction	5	6
Mining	less than 1	less than 1

Note: Table extracted from the World Book (1986) and based on 1984 data.

Whenever there are competing uses for a fixed resource, conflicts for access to the resource can develop among users unless it exists in relatively unlimited quantities or is well managed. In economic terms, if the resource were a product, and competing uses were viewed as demands, elementary economic theory would suggest that a market price would develop for the product that would result in a balance between demand and supply. Such a market system where price resolves conflicts between users does not generally exist for water and air resources. This is because air and water exist in abundance and no mechanism exists to restrict the access of individuals to these resources (Leftwich and Sharp 1978).

The potential conflicts that could arise involving agriculture and water and air resources as a result of the trends described previously will take various forms. Conflicts may develop simply because of the attitudes of a changing population. For example, natural resource and environmental protection is favored primarily by those persons in upper income brackets or having advanced education (Dye 1981). Recent statistics indicate that a high percentage of Maryland residents is well paid and well educated (Table 4). As the proportion of Maryland residents that is "urbanized" or "urban-recently-turned-rural" increases, it is easy to imagine that the proportion of the population with little knowledge about agriculture also will increase. These persons will be unlikely to tolerate environmental damage by agriculture or other

Table 2. Population and land use trends in Maryland

1980 Maryland Population — 4.2 million	
79 %	Urban
20 %	Rural
1 %	Rural farms
1970-80 Population Changes	
9.6 %	Decrease in rural residents
12.7 %	Increase in urban residents
1970-80 Housing Unit Changes	
25.5 %	Increase in housing occupied year-round
1973-85 Land Use Changes	
26.6 %	Increase in residential land use
4.7 %	Decrease in agricultural and forest land use
1975-85 Farm Changes	
6 %	Increase in number of Maryland farms
17 %	Decrease in the average size of farms
1982-87 Farm Changes	
8 %	Decrease in number of Maryland farms
3 %	Increase in the average size of farms

Sources: Department of Commerce 1983; 1984; Maryland Department of State Planning 1986; Maryland Department of Agriculture 1987.

sources (Farrell 1987). They also may be intolerant of agricultural needs for water, or of the impacts on air quality that typical agricultural operations can have. This is not to say that agricultural producers are not also concerned about the environment.

Table 3. Population changes in selected Maryland counties

	Percentage Population Change, 1970–80	
County	Urban	Rural
Anne Arundel	62.2	-52.7
Calvert	0.0	67.5
Caroline	0.0	17.0
Carroll	176.2	23.7
Charles	342.6	-0.4
Queen Anne's	0.0	38.5
St. Mary's	76.6	14.4
Washington	54.9	-22.3
Wicomico	25.4	16.5

Source: Maryland Department of State Planning 1986.

Possible Conflicts for Water

Availability of water is a function of many things, including precipitation, geology, topography, and land use, as well as population and development patterns. Overall, Maryland is water rich, meaning that the supply of water generally exceeds demand. Over 20,000 billion gallons of water fall or flow through the state's boundaries each year, or about 55 billion gallons per day (Walker 1970). On a per capita basis, this volume would supply 5 million gallons for each Maryland resident, enough to fill a line of tanker trucks 15 miles long (Magette 1987). This volume does not include the vast ground water resources of the state.

In 1985 average daily withdrawal of water amounted to 25.2 billion gallons per day (Maryland Department of Natural Resources 1987b). This was approximately 46 percent of the daily amount of water supplied by precipitation and streamflow from adjacent states. Almost all of the water withdrawn was used by power plants and returned back to the water resource system rather than consumed.

Agricultural withdrawal of water was only a minor percentage of total water usage statewide. In 1985, 42.4 million gallons of water were withdrawn daily for agricultural uses, less than one-tenth of one percent of the total water withdrawn (Maryland Department of Natural Resources 1987b). By comparison, the amount of water withdrawn in 1 day by power plants could irrigate 35,000 acres of corn in Maryland for an entire growing season with no rain. Understandably, the state's water managers do not foresee major water supply problems in the near future for Maryland as a whole (Maryland Department of Natural Resources 1987a).

However, localized water supply problems have occurred in the past, and problems may develop in the future. These mainly involve ground water and include

- limited ground water availability in certain outcrop areas,
- saltwater intrusion in certain coastal areas,
- overwithdrawal of water from some coastal plain aquifers,
- conflicting zones of depression and well interferences,
- seasonal and weather related variation of ground water, and
- variability and unpredictability of ground water occurrence.

Irrigation is the major agricultural use for water, and more than 50 percent of this demand is satisfied by ground water. Between 1975 and 1982, the acres of crops irrigated increased 86 percent (Brodie et al. 1984). Consequently, several of the problems listed above could easily involve agricultural users. Conflicts would

Table 4. Maryland income and education statistics

Annual Income, 1979	Family Households Percentage of Total	Nonfamily Households Percentage of Total
$25,000 to $49,999	36.8	14.2
$50,000 or more	6.9	2.4
Years of School Completed	**Persons Over 18 Percentage of Total**	**Persons Over 25 Percentage of Total**
High school, 4 years	34.8	32.5
College, 1 or more years	52.4	35.0

Source: Maryland Department of State Planning 1986.

most likely occur in areas where agricultural water demand is already high and substantial population growth is projected. These would include Eastern Shore and other coastal plain counties, where over 90 percent of the irrigated acreage in the state is located (Brodie et al. 1984). Both coastal plain and noncoastal plain counties where agricultural water use was 10 percent or more of the total water withdrawals (in 1985), and where the 1980 population is projected to increase by 10 percent or more by the year 2000 are identified (Table 5).

That population growth in rural areas can stress the natural environment was recognized in the mid-1970's (Council on Environmental Quality 1976). Recently, conflicts over water have developed because of rapid population growth in other areas of the country, causing major changes in water law. For example, Florida declared all waters of the state to be subject to regulation and established an administrative structure for that purpose in response to rapid population growth and agricultural development (Baldwin and Carriker 1986). In a major test of the regulation, the Florida Supreme Court held that a municipality could not be held responsible "for a taking, from private ownership for public purposes, of underground, shallow aquifer water, to the extent that the owner is deprived of the beneficial use of the aquifer" (Baldwin and Carriker 1986, p. 114). In practical terms the ruling upheld the legality of allocating water to specific entities for specific uses.

In Texas increased demand for water by agricultural, municipal and industrial users resulted in the construction of numerous surface water impoundments that subsequently caused significant changes in the fresh water inflow to important estuaries (Kaiser and Kelly 1986). Because fresh water inflows are a major determinant of estuarine productivity, legislative and administrative procedures are being sought to preserve these inflows. Among the solutions suggested are cancelling existing water use permits by changing the statutory definition of non-use, zoning restrictions, and protecting estuaries by invoking the "public trust" legal doctrine (Kaiser and Kelly 1986).

In Texas, Florida and elsewhere, reform of water laws is taking two paths (Miller, Heath and Sneed 1986). One path involves using legislative actions to enact provisions that fundamentally alter water rights. The other path involves using the legal system to modify existing common law principles to meet changing definitions. In the latter situation, decisions depend on perceptions about the public welfare—perceptions that are subject to change as the demands of the society change. As the population of Maryland becomes more and more nonagricultural in character, future legal decisions regarding water also may assume a nonagricultural focus.

The potential for water supply conflicts developing in Maryland is offset by the state's managerial ability to regulate the use of water. In 1987, the Maryland legislature passed amendments to the Natural Resources Article of the Annotated Code of Maryland (Water Appropriation Law) in an effort to improve the ability of the Department of Natural Resources (DNR) to manage the state's water resources. As amended, the law requires all significant users of water—including agricultural producers—to obtain a water appropriation permit from DNR. Once a permit is obtained, the state recognizes the user's right to use the permitted amount of water except when shortages develop because of drought. The DNR's Water Resources Administration is responsible for analyzing the potential impact of individual appropriation requests on the resources and other users of the resources (Maryland Department of Natural Resources 1987b). The agency also assesses the collective impacts of appropriations on a region and can mediate between users to resolve conflicts.

The Water Appropriation Law is an effective tool with which to avoid conflicts for water. Based on the knowledge of aquifer characteristics, DNR can allocate available supplies of water on a first-come basis, as well as prioritize the use of water among users should shortages develop. DNR also can respond to subsequent requests for water with an appropriate water source.

Localized conflicts for water may develop, however, when projections of water availability are in error. Projections of available supply are based largely on mathematical models that simulate the performance of the natural water supply system. In some cases, imperfect knowledge about factors that influence the natural system can cause errors in predicting water availability. In other instances, there are not enough physical data

Table 5. Projected population growth, water demand increase, and current agricultural water usage in selected counties

	Population Change Percentage[1]		Water Demand Increase[2]	1985 Agricultural Water Use[3]	
County	1970–80	1980–2000	MGD[4]	MGD	Percentage of Total
Caroline	17	15	4.8	9.2	71
Frederick	35	39	62.2	3.9	17
Garrett	23	17	6.3	1.1	15
Howard	92	79	130.4	0.3	11
Queen Anne's	39	45	16.1	4.7	61
St. Mary's	26	37	30.9	2.2	23
Somerset	1	10	2.7	1.9	43
Talbot	8	12	4.3	1.6	30
Worcester	26	27	11.6	2.3	18

[1] Population figures from Maryland Department of State Planning (1986).

[2] Water demand increase calculated from projected population increase and average daily water withdrawal for all uses of 1,400 gallons per day per person (United States Geological Survey 1988).

[3] 1985 agricultural water use figures from Maryland Department of Natural Resources (1987b). Total water withdrawals for calculating agricultural water usage percentages excluded power plant withdrawals.

[4] MGD = million gallons per day of water.

about some systems to define precisely how much water is available. These uncertainties exist largely with ground water.

In the future, potential conflicts for water should be avoidable or solvable with continued monitoring, long-range planning and effective management (Maryland Department of Natural Resources 1987a). Conflicts arising from the failure of models to accurately predict water availability can be minimized. Researchers need to improve their understanding of the characteristics that define water supplies in Maryland, especially aquifers, and improve models so that they accurately represent the real world. Consequently, the state's water management strategy must continue to have strong research and monitoring components. Local governments must also include water availability in all land use planning.

Experience elsewhere stresses this need for aggressive water resource research and monitoring. California courts, for example, have held that "the state is not confined by past allocation decisions which may be incorrect in light of current knowledge or inconsistent with current needs" (Kaiser and Kelly 1986, p. 136).

Technologies exist or can be developed that will reduce the withdrawal of additional water from ground and surface supplies. The use of sewage effluent for irrigation of agricultural crops is widely practiced in the United States. Likewise, recycling power plant cooling water and clean industrial process water through the soil profile and into unconfined surficial aquifers also can be a means to replenish ground water supplies. Such ground water recharge practices may become essential as rural areas continue to be urbanized and divert more rainfall into direct surface runoff from rooftops, sidewalks, roads, parking lots and other impervious areas.

Research and development for water reuse, desalination, drought-resistant crops and other water quantity saving technologies is already underway worldwide. Florida and California have made considerable advances in water conservation and reuse. Israel has advanced the use of efficient irrigation and desalination. These technologies require considerable financial investments and, therefore, require an economic return for the water made available for use. The current water situation in Maryland does not warrant the use of such practices.

Possible Conflicts for Air

The potential problems posed for agricultural production by degraded air quality have been well publicized. Acid rain and the depletion of the ozone layer are recognized effects of urban and industrial activities on the atmosphere. To date, ozone is the only pollutant whose injurious effect on forest trees has been proved beyond reasonable doubt (Cowling 1987). The adverse impacts of ozone or other pollutants on other agricultural crops is continuing. Acid deposition on agricultural soils is not thought to be detrimental because these soils usu-

ally are limed as a standard agricultural practice for pH control. State and federal statutes are in place to control industrial effects on air quality and, if enforced, presumably will provide the control necessary to prevent environmental degradation.

> ***"Air quality degradation by agricultural activities is not currently regulated. Ironically, however, it is those engaged in agriculture that are most likely to be adversely affected by air pollution of this nature."***

Conversely, air quality degradation by agricultural activities is not currently regulated. Ironically, however, it is those engaged in agriculture that are most likely to be adversely affected by air pollution of this nature. Dust, ammonia, hydrogen sulfide, chemical spray drift, methane and animal odors are some of the products released into the air from farming operations. Because the overall concentrations of these substances are normally low and the dilution rate is high, conflict with others usually is limited to close neighbors.

A growing exception is the conflict caused from the odors produced by animal populations. As animal populations and concentrations increase, so do smells. Animal stocking densities per farm are increasing for a combination of reasons including the general reduction in farmland acres, the inflow of investment capital, the development of improved technology, the decline in profit margins, and pressure from large integrated feed production or food processing companies (Table 6).

Odor is not limited to the very large animal production units. Many small farms have adopted a manure storage technology appropriate for response to water pollution and nutrient management concerns. Unfortunately, long-term manure storage increases the intensity of objectionable odors and the probability of neighborhood air quality conflict.

Odor is a very difficult parameter to qualify or quantify. People have different preferences for odor and variable thresholds for good, bad or unbearable odors. A city dweller may take little offense at the smell of automobile, bus and truck exhausts, since these odors are expected and accepted. Likewise, a hog farmer expects hog manure to smell as it does and accepts the odor as a condition of employment. This does not mean that all farmers accept odors equally. Hogs may have a worse odor than cows or vice versa, depending on the experience of the particular individual. These comparisions illustrate that conflicts are possible over air quality because people perceive odors differently based on their backgrounds. Data in Table 6 suggest those counties in which conflicts over odors from agricultural operations are likely to occur. In these locations, significant changes in animal densities have occurred already and substantial population growth is projected for the near future.

Odor is a social problem. People realize odor problems immediately and react in a variety of ways that range from total acceptance to feelings of rage. Odor in itself poses no physical health problem to humans or

Table 6. Animal densities and trends for selected counties in Maryland

County	Livestock Densities: Animal Units per Acre of Farmland	Livestock Densities: Percentage Change 1970–1985	Projected Human Population Changes 1980–2000
Caroline	0.29	71	15
Frederick	0.35	16	39
Garrett	0.26	19	17
Howard	0.19	-13	79
Queen Anne's	0.10	-10	45
St. Mary's	0.14	35	37
Somerset	0.42	21	10
Talbot	0.10	-23	12
Wicomico	0.65	63	18
Worcester	0.45	39	27

Note: An animal unit is 1,000 pounds of animal weight.

animals. However, psychologically induced physical symptoms of declining health can occur from forced contact with undesirable odors. Once a bad odor is identified, those adversely affected will not rest until the source is eliminated. Such individuals have little interest in compromise.

Unfortunately, there are very few technical solutions to odor situations. Technology applicable to the animal production unit for the reduction of odor is very limited. Although there are a variety of manure and feed additives that are advertised for odor control, there is no conclusive evidence that any provide the remedy desired. There are no methods of changing the body odor of animals, but improved methods of siting new animal production facilities, and of manure collection, handling, storage and land application can be used. These will help control odor, but the odor cannot be eliminated.

Local governments must recognize farm odors as a factor in land use planning. Plans and designs for new animal confinement facilities should be reviewed to ensure that odor reduction technologies are being adopted. Separation of odor producing activities from areas of potentially adverse reaction may be necessary also. Proposals for new subdivisions in agricultural areas must recognize the potential for conflict over animal odors and other issues. Local Extension and Soil Conservation District personnel with expertise in agricultural technologies should be recruited to help review activities and develop remedial solutions to odor problems. Finally, research in the chemical and biotechnical aspects of livestock odor production and control must be supported. Methods need to be found that might change the body odor of animals, increase the feed digestion efficiency, reduce the amount of waste produced, and provide improved waste treatment.

Without the ability to prevent odor problems before conflicts develop, or without the development of better technological solutions for odor control, air quality complaints will continue to intensify as rural and agricultural areas become increasingly urbanized. The inevitable decision that agricultural producers will have to make is whether to continue producing animals and some odor, to buy odor control technology, or to sell out when urban encroachment is inevitable.

Summary

Air and water in Maryland are free goods, available to all users. Maryland is water rich, meaning there is generally an abundance of water of necessary quality to satisfy all needs. Likewise, there are no overall air quality problems associated with agriculture. Localized conflicts will develop, however, if the resources are not well managed or if population growth into agricultural areas continues unabated.

Local governments must begin to routinely include air and water resource considerations in land use planning activities. Likewise, agricultural producers must work with local governments to make sure local decisionmakers understand agricultural production practices and the dependence of agriculture on water and air resources. Serious research, monitoring, and educational efforts regarding water and air resources can help avoid conflicts, and are activities that must be pursued.

Changing demographics suggest that agricultural producers will come under closer scrutiny in the future as Maryland's nonagricultural population continues to increase, as more and more political decisions about the environment are made by local governments, and as the influence of agriculturalists in those decisions continues to decline. These trends also suggest that the potential for conflicts to develop over a variety of natural resources will increase.

In an era of high demand for land development to house an increasing population, and of low profit margins for agricultural products, the challenge for today's policymakers is to ensure that conflicts between agricultural and nonagricultural users of water and air do not develop and become one more reason for Maryland's producers to leave the agricultural sector.

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Land-Use Management and Policy

Norman A. Berg

The Current Situation

Maryland

When assessing the current status of agriculture in Maryland and checking its vital signs, one finds that some trends are not reassuring. Less land is being used for agriculture, and soil erosion in many areas exceeds tolerance levels. Each year thousands of acres, used for centuries for agriculture, are in transition to nonagricultural activities. Each year millions of tons of soil end up as sediment. Also, each year there are fewer Maryland citizens primarily identified with agriculture. According to a U.S. Department of Agriculture (USDA) survey, there are 16,000 farms operating in Maryland. This is down from 16,500 last year and 17,000 the year before. The past three years of this decline is attributed to below normal rainfall, poor prices and the pressures of continued development. The survey revealed that the total farm acreage is not dropping as fast as the number of farms. The acreage declined from 2.45 million acres last year to 2.35 million acres. Some farmers who have quit planting are renting their land to other growers. The Soil Conservation Service (SCS) identifies about 30,000 operating units for purposes of servicing other programs. Each year the gross income from agricultural enterprises is less. Cash receipts in 1987 were about $1.2 billion. There are other trends that have an impact on agriculture, such as proximity to markets, service shops and neighbors unfriendly to farming. Maryland shares these trends with many other states.

The total area of Maryland is 6,694,500 acres. Of that total 89,000 is Federal land and the rest is mostly privately owned. The breakdown of land cover and use is

- 2,425,300 acres of forest land,
- 1,799,000 acres of cropland,
- 1,360,100 acres of wetlands,
- 534,100 acres of pasture, and about
- 576,000 acres identified as miscellaneous and census water.

United States

Agriculture is of major importance to the economy of the United States. Agriculture generates 20 percent of the nation's gross national product and 20 percent of the national employment. American agriculture is a production miracle. Fewer than 2.5 percent of the U.S. population, using only about 60 percent of production capacity, provide high quality food and fiber to 240 million citizens at a less cost, as a percentage of income, than any other country in the world. The underlying forces, including abundant resources, technology and ability of the producers, have given this nation, and Maryland, reasons to applaud agriculturists. There are several basic economic forces that have shaped the present form of agriculture, including the way land is used.

The late Dr. Richard Bradfield of Cornell University stated that modern American agricultural productivity rests on three things:

1. the use of hybrid varieties of corn and other crops that have been bred for high yields under good fertility and for maturity within growing seasons of a particular time;
2. the use of large, highly powered and sophisticated equipment for almost all agricultural operations; and

3. the availability of specialized agricultural chemicals, including uniform concentrated mineral fertilizers that are easily applied at high speed, and specific herbicides that eliminate the need for repeated cultivations by machine or hand labor.

The underlying force that drives this integrated system is the need to reduce labor costs, particularly the time spent in the field. It is this consideration, which now makes it possible to raise a bushel of corn with only a few minutes of human labor in the field. This drive to reduce costly human labor characterizes America's present agricultural system in contrast to traditional methods that are still dominant in many parts of the world, where the principal goal remains yield per unit of land area rather than a unit of labor.

In recent years it has become evident that the side effects of this intensification have begun to appear as adverse impacts both on the farm itself, which may appear in terms of reduced productivity (on a per acre basis), as well as in the quality of the surrounding environment (Bradfield 1960).

"This drive to reduce costly human labor characterizes America's present agricultural system in contrast to traditional methods that are still dominant in many parts of the world, where the principal goal remains yield per unit of land area rather than a unit of labor."

If Bradfield is correct, what meaning will the past have for the future of agriculture in the United States and elsewhere? Maryland, as well as most other states, has a significantly limited acreage of prime or important farmland. Also, this type of land has a high potential for nonagricultural uses, especially if it is in proximity to metropolitan areas. According to the USDA (1987) National Resources Inventory (NRI) study of potential cropland, usually any expansion of cropland acres brings lower quality land into production. The conversion problem continues despite Maryland's program for retaining land for agriculture. This program is the best in the United States, but the state is losing 2 acres for each acre saved for agriculture.

Loss of prime and unique lands to other purposes will place additional stress on the resource base still available for agriculture. Soil loss from erosion is a serious problem, and soil lost to urbanizing needs is irreversible. Maryland must retain an adequate resource base for farming in the state to be viable.

Maryland's Agricultural Land Preservation program, established in 1977, has 1,000 agricultural preservation districts, protecting 147,000 acres. Development right easements have been purchased for about 400 farms protecting 70,000 acres. Since early 1985, soil and water conservation plans have been required for farms selling easements. In spite of program participation, the conversion of farmland continues to exceed the amount of farmland preserved. Farmland loss in Maryland has increased each year—25,000 acres were converted in 1986. The 1981 Farm Bill established a national Farmland Protection Policy, with amendments in the 1985 Farm Bill. However, USDA has not issued an updated rule. **Maryland, A Middle Temperament, 1634-1980** by Robert J. Brugger, states that in many respects, Maryland's story is America's—bulldozing beautiful farmland into extinction. Of all the non-Federal land in Maryland, 119,300 acres have a high potential for conversion into cropland, and 387,300 acres rate as medium, if ever needed for cropland use.

Critical Issues

Is a sustainable, prosperous agriculture a long-term goal for Maryland? The answer to this question is made more difficult and complex by the searing droughts that have plagued Maryland farmers over several production seasons. To ensure that there will be a future for Maryland agriculture could be a challenge for every Maryland citizen. The next 10 to 15 years pose a few high priority issues that need immediate attention. Many other issues will demand solutions over the long term. Emergency situations, such as the impact of a drought is a critical issue. Early and meaningful action is essential for some to survive. Congress responded with legislation and funds to cushion the hardship of some in agriculture. It is not known how effective that action will prove to be. However, based on historical data, normal precipitation and production conditions will return. Droughts, though traumatic, are temporary, while overproduction of some commodities is chronic. Therefore, over the long run, Maryland's farmers who compete with other producers of corn, soybeans, wheat, poultry, dairy products, and other food and fiber, must do so in both the national and international economies. Those representing eco-

nomics, research, trade, finances, consumer concerns, biotechnology, and social and other sciences, can expect that the competitiveness of Maryland agriculture will be enhanced, particularly from the standpoint of technology.

Agriculture and the Environment

Some people have described agriculture and the environment as a battleground. Whatever one's interpretation of this scenario, the relationship between agriculture and the environment is a very important issue. There is need to work with the environmentalists as soil and water resources are used more intensely for all purposes.

According to Maryland Agriculture Secretary, Wayne A. Cawley, Jr., " . . . the flurry of agriculture legislation and regulations passed over the years is making it more difficult for farmers to turn a profit from their land." He added, "It's getting to the point that many of them are saying, 'The hell with it,' and selling out. They are on us about pesticides. They are on us about pollution. They are on us about erosion. They are on us about all these things. Those people who say we don't have to worry about farms in Maryland, that the Midwest will take care of us . . . well, this year's (drought) is a good example of flaws in that thinking."

Soil and Water Conservation

How effective have the traditional soil conservation programs been in Maryland? Have they helped or hindered the future of agriculture? Are changes needed for improved use of land? The discussions leading to the Conservation Title (XII) of the Food Security Act of 1985 indicated need for some new tools to deal more effectively with conservation problems of today.

Conservation of soil and water resources is a continuing issue, one that has been recast repeatedly in revised or new programs as chronic problems persist or new ones arise. There is over half a century of Federal, state, local and private sector participation in programs to address soil erosion, water quantity and quality for agricultural uses, and the mapping of land best suited for crops, pastures, trees or wildlife. There is a long history of soil conservation districts, and cooperators, voluntarily acting as land stewards to ensure the proper use of land. Much has been accomplished. Until this decade, two basic themes have driven these efforts: (1) that soil erosion must be controlled so that cropland productivity is sustained over the long term, and (2) that sufficient water of good quality be provided for agricultural use to enhance productivity. For over 50 years Congress has responded to both themes, which relate primarily to agricultural production and onsite impacts of soil and water use. Despite this history of strong support for these traditional soil and water conservation programs, chronic problems persist that have not been solved by past programs and actions.

Now, in this decade, two new conservation themes have emerged. The first theme involves integrating soil and water conservation programs with Federal and, to the extent possible, state and local governmental land policy. This has been partially done in the Food Security Act of 1985 by the creation of programs to reduce soil erosion, and control production of some major commodities with a history of annual yields that exceed the domestic and export market. The soil conservation provisions of the 1985 Farm Bill are being implemented.

The second new theme involves the growing acceptance that agricultural activities can have adverse impacts off the farm. This has been one major reason for Maryland's participation in reducing nutrient loadings into the Chesapeake Bay from nonpoint sources. The increase in financial and technical assistance available to land users is a direct result of traditional soil and water conservation programs that are addressing the potential impact of agricultural pollutants off site and reducing onfarm soil erosion and runoff.

"The flurry of agriculture legislation and regulations passed over the years is making it more difficult for farmers to turn a profit from their land."

Before this decade, environmentalists had a limited role in national debates on farm and soil conservation policy. By 1985 the growing evidence that farming contributed to some critical environmental problems, led to significant actions by nonfarm organizations. Concern that traditional soil conservation work of the past half century needed updating, brought new concerns. Issues involving wildlife, wetlands, forestry and quality of water were brought into the national discussions and decisions about agricultural policy and future impacts.

Support Program and Conservation Policies

USDA and land-grant universities have programs that provide farmers with research, education, and financial and technical assistance. These services, supported for

many years by the public, with some private funding, have developed a delivery network with an excellent record. This foundation has been laid for the future that represents a partnership arrangement. Each level of government then, is expected to play its unique role. For example, soil and water conservation programs require that the states have enabling acts for the formation of local soil conservation districts.

Maryland is one of several states with a good record in contributing valuable non-Federal initiatives and resources. The Agricultural Water Quality Cost-Share Program has been in operation since July 1983. This activity provides for sharing the land user's cost of installing a variety of Best Management Practices (BMP's). Over 2,400 projects have been completed with $8,400,500 of Maryland funds. In addition the state and local governments have accelerated the soil and water conservation work by adding technicians.

Recent assessments of current conditions have indicated the value of past soil conservation programs, but have revealed soil erosion at or above acceptable levels on one-third of the cropland in the state. The soil loss from other uses of land is much less, but also needs to be reduced. However, the emphasis on conservation tillage, as a key management tool for reducing soil loss from cropland, has added to the concern of those opposed to the use of chemicals to control weeds and pests that can reduce agricultural yields. Management of all nutrients (for example, livestock and poultry waste, inorganic fertilizers and sediments) relating to food and fiber production, is increasingly viewed as an environmental issue. The programs of the past have not given management problems highest priority. The direct relationship of accelerated soil erosion to long-term soil productivity has been masked by technologies (such as crop varieties, herbicides and improved machinery) that have continued to increase annual yields of major commodities. The concern for a sustainable agriculture, including a nondegradation policy for soil quantity and quality, is directly pitted against the periodical national control of farm production.

Non-Federal programs have proliferated in Maryland, primarily because of Chesapeake Bay water quality problems and not because of concern for a viable, prosperous agriculture. However, to separate these two issues in improved land use management and policy, for whatever objective, is not wise. The four themes previously mentioned are related. The voluntary approach, with incentives as the carrot, has a 50-year history. Since agriculturists will probably resist too much regulation, strategy statements for critical issues will make sense if the intent to ensure the quality of soil or land for agriculture is clear.

Maryland's Soil

Not all soils, as created by nature, are equal. Therefore, the proper use of land, based on what it can tolerate, is important. The inherent capability of a resource, such as soil, has long been identified by soil surveys. In Maryland, about 932,000 acres of cropland are listed as having an erodibility index (EI) of less than 5. Erosion potential is the inherent ability of the soil to erode, considering properties of the soil and the local climate. It is the rate at which land would erode if there were no cover crops or conservation. EI is the numerical expression of the soil erosion potential. The T value is the rate at which soil can be lost while still maintaining long-term productivity. This can vary from 5 tons per acre per year to 1 ton per acre per year for different soil types. EI is a multiple of T, so soil with a T value of 5 and an EI of 5 has the potential to erode at 25 tons per acre per year. The higher the index number, the greater the erosion potential.

About 220,000 acres in Maryland have EI values between 5 and 8, 268,800 acres are listed as having EI's of 8 to 15, and 327,700 acres have EI's greater than 15. This data, based on the 1982 NRI, is evidence that some soils that should be used less intensively are used as cropland. Any reduction in the 9 million tons of soil erosion each year will make a substantial contribution to a reduction in the quantity of sediments from agriculture that can impair water quality, navigation, fishing and recreation.

Counties in Maryland with the highest percentage of their total cropland being identified as highly erodible include Anne Arundel, Harford, Baltimore, Washington, Cecil, Howard, Frederick, Prince George's, St. Mary's, Calvert, Montgomery and Carroll. Every county has some highly erodible cropland. The most erodible soils, with the largest acreages in Maryland, include Manor (430,000 acres), Beltsville Silt Loam (172,000 acres), Matapeake Silt Loam (164,000 acres), and Mattapex Silt Loam (157,000 acres).

Agricultural producers who use highly erodible soils should be implementing a basic conservation system so the EI is less than the T each year. There are about 390,000 acres of cropland whose EI value exceeds the T value. An acreage that exceeds 2T may cause the possible loss of the Federal farm program benefits since conservation compliance begins January 1, 1990.

To ensure that land is used properly in Maryland, land users will have to be concerned with resource management. Nutrient management by farmers, and livestock and poultry producers, is an area that will be monitored more closely in the future. A key to the economic recovery of farmers will be more careful use and

management of fuel, fertilizer and pesticide inputs. Recycling of agricultural wastes can benefit both the producer and the environment.

Effects of Pollution Control

Without intending to do so, past agricultural programs and policies have encouraged producers to move in the direction of intensive monoculture or simple rotation systems (such as corn, soybeans, corn, soybeans). This has led to a substantial use of mineral fertilizers and herbicides, thus tending to increase pollution. The long-term USDA farm policy, (fence-row-to-fence-row plowing of the 1970's), supported by the public and the administration contributed to these problems. An emerging challenge for the future of agriculture in any state will be the nonpoint source pollution problem. The issue is primarily who will pay for the benefits of these measures. The land users are expected to be good stewards, but the social benefits of installing BMP's on private lands requires a sharing of the cost of these practices.

The acceptance of the magnitude of agricultural nonpoint source pollution has not been a high priority in the United States until recently for three reasons:

1. Point sources of water pollution are more visible and can be monitored and controlled.
2. It is apparent that water quality problems remain in spite of significant and costly implementation of many point source control programs.
3. Most ambient water quality monitoring activities designed to characterize the impact of point sources of pollution greatly underestimated the magnitude of nonpoint sources.

Research and monitoring are still needed for a full understanding of the impact of agriculture on the environment. The magnitude of agricultural pollution problems has a direct relationship to the intensive industrialization of U.S. agriculture. Increased reliance on inorganic fertilizers, pesticides and monoculture since World War II probably has resulted in more off-site impacts than would have been possible given more extensive, less intensive, agricultural practices.

Maryland citizens are not ignoring the impacts of agricultural use of land on the quality of surface and ground waters, and farmers and producers also are concerned about water quality. They will accept a reasonable share of the responsibility for improved water quality, but many pollution problems originating from nonpoint sources are beyond their ability to correct. There are other land users, contributing to the nonpoint source problem. Since sediment control during and after construction is a high priority problem for several areas, attention should be given to the transition of land from rural to urban uses.

The Chesapeake Bay Restoration Program

Ninety-five percent of the land in Maryland drains into the Chesapeake Bay. Any pollutants that wash off this land or are discharged into any creeks or rivers eventually wind up in the Bay. The remedy of nonpoint source pollution will not be simple or inexpensive. Nonpoint sources of water pollution are characterized by the seemingly insignificant nature of their individual contributions, the damaging effect of their cumulative impact, the complex set of natural processes acting to modify them, and a variety of social and economic interactions.

A potentially frustrating issue will be that the massive efforts to help the ailing Chesapeake Bay may not be successful, unless severe growth limits are adopted and implemented by the year 2020. This may depend upon whether the public will support a viable, stable, prosperous agriculture as an offset to unlimited development. Is the public ready for statewide land-use plans, tougher zoning, greater protection of valuable wetlands, and retention of prime and unique agricultural soils? These are some of the long-term issues and conflicts that are posed as a challenge to those concerned about the environment and the future of agriculture in Maryland.

Conclusions

The only thing certain about the future is that there will be a future. Therefore, what are the issues that are likely to develop over the next 15 to 20 years? The technical knowledge needed to apply soil and water conservation measures is already ahead of the acceptance by many land users. The motivation to adopt measures is not a simple matter to examine and more research is needed. Farmers do not want to lose soil, contaminate the quality of surface water, ground water or wells, or kill fish or damage wildlife habitats. However, farmers need to survive. They are interested in reducing the costs of producing food and fiber. Methods are being researched, alternative systems for farming are being developed and practiced in several regions of the country, and several conferences on related issues have been held and more are planned.

Policy and action programs of the past few years will be refined, strengthened in the future, and patterned after the Conservation Title (XII) of the Food Security Act of 1985. There are four major provisions in this important law:

1. the Conservation Reserve Program (CRP),
2. the conservation compliance requirements,
3. the swampbuster features, and
4. the sodbuster features.

For the first time, these provisions link the USDA farm and conservation policies for highly erodible cropland. The CRP offers an incentive to land users to convert their highly erodible land to an acceptable vegetative cover. In return, for a 10-year period, they will receive an annual rental payment. A cost-share provision also assists in the establishment of the planned cover (grass, trees or wildlife plantings). About 400,000 acres of Maryland cropland could qualify for CRP. The goal is to enroll about 100,000 acres. This is not an easy task for a variety of reasons that are now being addressed within the state. Addition of filter strip bids, and a state bonus for some lands, may enroll more CRP acres.

"The concern for a sustainable agriculture, including a nondegradation policy for soil quantity and quality, is directly pitted against the periodical national control of farm production."

By 1990, conservation compliance requirements will have an impact on the highly erodible lands that are still being cultivated. Unlike CRP, conservation compliance is not a voluntary decision. Conservation compliance requires that a land user who is cropping highly erodible land and still intends to benefit from Federal commodity, credit or insurance programs must develop a conservation plan for that acreage to be approved by the local soil conservation district. The land user must apply the plan by January 1, 1990. The date set in the law for the plan to be fully implemented is 1995. SCS has the capacity to have all plans developed, if land users need assistance. Swampbuster and sodbuster features are provisions that should slow the conversion of certain wetlands or highly erodible lands that are now in grass or tree cover to cropland. The rules and regulations for all features are available in all county USDA offices.

Emerging Issues

USDA will soon release **A National Program for Soil and Water Conservation, the 1988-97 Update.** This document will provide some guidance as to USDA priorities for the eight agencies that have soil and water conservation programs. The top priority will be the reduction of erosion on agricultural lands, with emphasis on the implementation of the Food Security Act of 1985 that requires protection of highly erodible land and wetlands. The plan also endorses continuation of the conservation partnership. The quality of surface and ground waters is an important issue.

There will be more attention in the U.S. Congress to soil and water conservation issues in relation to continued production of food and fiber. Attention to the off-site impacts of this production will be an increasing priority. The 1985 Farm Bill (Conservation Provisions) has set a course for future Federal legislation: Senator Wyche Fowler (Georgia) has a new current bill, SB2898 that will be reintroduced in the 101st Congress.

Discussion are already underway on conservation policy for the next major Farm Bill (1990). This will likely contain some fine tuning of the 1985 legislation. Everyone involved in agriculture needs to recognize that the protection of and improvement of water quality is rapidly emerging as the dominant resource conservation issue for American agriculture. Maryland is already participating because of the action in the Chesapeake Bay programs.

The degree of control that the agricultural community will retain over the agenda will be a significant issue. The question of the effectiveness of incentives on voluntary action for obtaining results in a reasonable time will be debated in relation to the value of stronger regulatory action. Those who were involved in the development of the 1985 legislation hope to guide the policy process towards voluntary compliance. Such an approach to the control of erosion and the achievement of water quality goals is critical. There are also additional supporters who advocate low-input and sustainable agriculture as a desirable alternative farming system.

Other issues being considered include

- encouragement of accelerated enrollment in the present CRP before 1991 and the expansion of the goal from 45 to 65 million acres,
- inclusion of lands that impact water quality as part of CRP,
- changes in reliance on government commodity program payments, and
- encouragement of increased research and action programs for low-input/sustainable agricultural systems.

Finally, there is one set of questions:

- How are these new actions of the 1985 Farm Bill working?
- Would Maryland promote agriculture with appropriations?

- What are other states doing that will help Maryland?
- Should the state target soil conservation to those lands that affect the Bay the most? Should Federal funds be redirected?
- What is the new policy intended to accomplish?

The increasing interest and influence of those concerned about environmental issues will probably have as much of an impact on the future of agriculture in Maryland and elsewhere as any other factor. Throughout the nation there is evidence of concern for water quality, wildlife habitats, and other quality of life matters. Farmers, ranchers and foresters are certain to be pressed to defend conventional production practices, if off-site results of managing land and water cause harm. Clearly agriculture has major effects on the environment, and therefore agriculturists should be involved in planning and applying corrective measures to respond to non-point sources of water quality problems.

In addition to listing those problems that need more work to assure a future for agriculture in Maryland, those individuals who are working each day to help solve problems also deserve mention. Members of the Soil Conservation Districts, their local governing boards, and the agencies assisting them are involved in helping land operators conserve and manage soil and water. Those involved need the support from the public that provides the tools needed to plan and apply conservation practices. Agriculturists should be partners in determining the laws that will have an impact on their operations, but should welcome others who have concerns that are compatible with proper management of land and water.

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Competition for Maryland Farmland

Jon K. Hutchison

Introduction

There is a difference between competing land uses and land use conflict. In that the same land cannot have two uses at the same time, one most certainly sees competition between agricultural and urban uses for Maryland's supply of rural land. In the United States allocation of land between different land uses is largely accomplished by the land market, which operates on an ability to pay model. The land use controls by local governments are a significant influence on this process, but tend to confirm and fine tune the collective decisions made by land sellers and buyers.

Land use conflict on the other hand implies a social problem. Land use conflict usually arises in resource fields when the interests of the individual are counter to the interests of the group or when the group's short-term interests run counter to its long-term interests. Land use conflict usually implies a vision of a better situation. If this vision is widely shared, the conflict tends to be resolved. Conflict continues where no shared future is envisioned.

Land use competition between farmers and land developers is driven by the nature of the resource. Prime agricultural land usually is prime development land. Land too wet or too steep to plant is usually too wet and too steep to build on. (However, low frequency flood plains are a possible exception. These areas are good farmland and poor development land. Also some soils that are not suited for septic systems, support agriculture well.) Designating land not suited to development as permanent farmland, is one limited route to farmland protection. Although this obligatory farmland approach can be useful at times, it will not protect most of the state's lands facing urban pressures. Perhaps 15 percent of the state's farmland falls into this category.

In 1987, Maryland lost an estimated 44,000 acres of farmland to development. This is about 2 percent of the state's farm base of 2.4 million acres. Many observers believe that the land market misallocates land, robbing the state and the nation of an irreplaceable resource. This is the motivator behind the incentive and regulatory programs, aimed at farmland or agricultural protection.

In the following pages the issue of the loss of farmland will be discussed from the perspective of a land development professional. In addition, opportunities to reduce the rate of land conversion, which are politically acceptable and economically affordable, also will be discussed.

Land Supply

On close examination, neither the supply of farmland nor development property is really finite. Land supplies are literally and functionally flexible. Engineers can convert marginal land to land capable of supporting crops or houses. Unfortunately, this process is costly and places environmental pressure on marginal lands.

The ability to supply food and fiber depends on the level of technology applied to the lands in agricultural production. The functional land supply can be extended through the application of improved technology. Over the years Americans have seen progressively greater yields despite a decline in planted acres. The green revolution boosted American yields by 1 to 2 percent annually for 40 years. The increases stemmed from

higher degrees of management, pesticide and herbicide applications, improved crop strains, and the application of energy through mechanization and fertilizers.

Some people argue that there is no farmland problem; they take two approaches: (1) Market economists claim crop prices will climb as land supplies dwindle. Presumably, the farmer will be able to bid against apartment builders for farmland when this situation progresses sufficiently. (2) Technological optimists hold that infinite increases in production are possible. Technology and rising yields will replace the lost land base with increases in production. This assumption is pretty heroic, but history does not support this position.

"Unlike the case with farmland regulation and prohibitions, public policy can control the demand side of growth and reduce the pressures put on farmland and forests."

The economists' position does more to protect traditional economics than it does to protect farmland. California vineyards are the only legal crop, which has been able to compete for near-urban land. The idea of market forces controlling conversion seems to carry with it high social costs. The optimists' position has been given credence lately. The recent slowdown in productivity increases seems to be reversing again with advances in biotechnology and genetic engineering. The high output model of farming is based on high inputs. The food system in the United States requires about 10 Calories of input to create 1 Calorie on the dinner table. Onfarm use accounts for about 3 of the input Calories. It is possible that about the same number of people are employed in the food system today as were 40 years ago. However, they are not farmers now; they are machinists at John Deer or fry cooks at Mac's (Steinhart and Steinhart 1974).

Energy inputs, massive soil losses, and pesticide problems affect the sustainability of agriculture. With the United States as a leader among the six or seven net food exporters of the world, there are serious political implications to the loss of U.S. productive capability. Indeed, recent years have seen the United States move toward an economic balance between food imports and exports. The United States tends to export low value products such as raw grain and import high value foods such as cheese and processed meats. The United States faces cost problems in that many of the world's potential consumers cannot afford American food.

The supply of development land is also affected by technology. The amount of land required for urban uses has declined steadily since the 1950's. However, absolute population growth and continued urbanization of the best agricultural counties continue to put pressure on the land. Good urban design stressing higher density residential use, high-rise buildings, mixed land uses, mass transit and telecommunications could cut the impact of urban growth on farmland greatly. Unlike the case with farmland regulation and prohibitions, public policy can control the demand side of growth and reduce the pressures put on farmland and forests.

Farmland Protection Policy

Most of the public effort to protect farmland has been directed toward the local level of government and has made use of land-use controls. Some non-Maryland communities have depended heavily on definitions of prime farmland to trigger controls over development. Typically, land with high productive capability as measured by U.S. Department of Agriculture (USDA) crop yields or by capability units is made more difficult to convert.

The prime soils approach is directed toward protecting the most productive agricultural soils. Programs that depend on soil productivity may ignore the complexity of farming. The value of pasture to a dairy or beef farmer generally is not recognized. Successful protection efforts cannot ignore the need for viable-sized farm units. The need for capitalization of the land also cannot be ignored. Protection by soil types also leads to scattered development, which will have a negative impact on agricultural land. Farmland protection efforts therefore must be integrated with an overall effort to stabilize and improve environmental quality. For example, in some cases, rural development is focused on slopes and wooded areas in an effort to protect productive areas. Housing pressure on these areas has a great effect on the visual landscape and wildlife resources. According to the prime farms approach, the farm, not the soil, is viewed as the protected unit. The goal is to keep an integrated unit composed of land, buildings, stock and operator in production in an environment that supports farming through markets and services. Functionally, this program concentrates protective efforts on the areas that are under the least pressure, but have the highest productive value.

Indicators of prime farms are adequate size, availability of rental land, good soils, capitalization of the land with buildings, a skilled operator, livestock, other markets, and nearby farm supply and service stores. Local

farmers can sit down with a marker and note the farms and areas where these conditions prevail. Twenty local farmers can inventory a county in an evening in this manner. The prime farm approach protects a valuable way of life. It protects a visible landscape of farm and field. It protects the small communities and small businesses that are supported by a healthy agricultural economy. The prime farm approach may protect the environment from both sprawl and corporate factory farming.

Land Development Economics

For residential development, land buyers in the Washington, D.C. market are willing to pay roughly 10 percent of the value of the finished dwelling unit for raw land that is lacking in urban services within the parcel. New homes in the Washington area now average about $170,000, which points to a raw lot in the $17,000 range. For prepared lots, the figure rises. Recent sales put the value of finished lots in the 25 to 30 percent range. Thus the value of finished land under an average home would be in the $50,000 to $60,000 range. Land is a higher component of housing prices at the lower end of the price range and for large-lot, single-family homes. Finished land in the 1950's and 1960's typically cost 10 percent of the unit's value with raw land likely in the 3 to 4 percent range. Partly because of rising housing costs, land use controls, and restricted urban services that constrained supply, the cost of land increased.

Today in most American major markets land is sold by the dwelling unit or DU right, not by the acre. Ads appear for lots at $17,000 to $27,000 a DU. Single family development runs from 1 to 4 units to the acre, with townhouses at 6 to 12 and garden apartments from 12 to 22 units to the acre. Zoning determines the units to the acre. To determine the value of a parcel, one multiplies the acreage, times the lot yield, times the DU value, and watches another farm disappear.

Communities that try to control growth rates through policies that restrict supply usually create inflated land and building values. Most observers suggest that a 3-year supply of development land in all submarkets is needed for adequate competition. While sprawl most certainly results in high costs of service, poorly planned growth control can affect the cost of housing.

Commercial development also is sold by density as established by zoning. Zoning confers the right to build on a set amount of space. Most codes establish a permitted floor area ratio. This is the amount of building allowed per square food of land. The floor area ratio (FAR) is a ratio of building to land measured in feet. Single story retail centers or offices tend to run about .25 to 1 or roughly 10,000 feet of building per acre to about .35 to 1 for a multiple story suburban office. Practically speaking FAR's are limited by parking requirements. Each square foot of building requires about a foot of parking. The value of a FAR foot of building rights varies widely according to location and the uses permitted by planning and zoning laws. Good suburban land is running $12 to $22 per FAR foot. In Tysons Corner or in the I-270 corridor $26 to $40 a FAR foot is common.

There is no real competition between farmers and land developers. Farming nets only 10 to 25 percent as much as urban uses. Raw land for homesites runs from

"A significant amount of conversion of farmland is caused by poor planning and coordination of urban services."

$12,000 an acre to $108,000 for single-family lots. Prices can climb to as much as $300,000 an acre for upper end high density locations. Commercial sites go for even more. Fast food sites can sell for more than a million an acre, while office locations cluster between $100,000 and $500,000 an acre. Since zoning conveys much and perhaps most of the value to raw land, there is a serious equity issue involved with the distribution of rewards and losses. Those who benefit by the more intense land use categories are the recipients of large unearned increments in value. Their land is worth more because of the capitalization created by the urban infrastructure. Others face the burden of restrictive policies such as Maryland's Critical Areas Legislation.

Land Use Controls

Land values in the ranges previously listed are enough to test a farmer's commitment to agriculture and explain why zoning breaks down under market pressure. Politically, it is hard to buck these land values with regulatory efforts that place land in the $1,000- to $3,000-acre range, which can be supported by farming. Legal challenges to conversion regulations depend heavily on economics. Court tests are expensive. Regulations that do not greatly affect value tend not to be challenged. The prospects for a major increase in value motivate owners to challenge developmental restrictions that severely affect a property's market worth. Maryland courts tend to look closely at the economic burden on the owner

and compare this burden with the development's impact on the public.

The state courts tend to balance the goodness of the regulation against the financial damage done to the land owner. A land owner who is precluded from reasonable development rights easily can make a case that land values are depressed by tens of thousands per acre. The court would then be forced to look at an ordinance that is designed to protect an industry that cannot in many cases survive on free land. Even in transitional areas somewhat distant from the urban fringe such as Howard, Charles and St. Mary's counties, a farmland approach that depends on prohibitions and regulation is unlikely to be accepted and will break down under political pressure and court challenges as land values rise. Against this economic motivation to sell out to developmental pressures, a number of land use controls that are in part designed to reduce the pressure on farmland are evident. Large lot zoning has been used widely to preserve the rural way of life. In so-called agricultural areas, the minimum lot runs from 1 acre to 5 acres in size in many counties. A few counties have tried greater lot sizes.

To be effective and slow development, the larger lot size has to increase the cost of the lot to discourage the buyer. If land sells on the building unit right, the commodity is not land, but the ability to place a structure on the land. Instead of buying an acre, the builder buys five. Land price does not go up fivefold. In a given area, there is little cost difference between 1/4-, 1/2-, 1- and 5-acre-lots in market price. Therefore large lot zoning may actually increase the consumption of land. A shift from 1-acre to 5-acre zoning has to cut demand by more than fourfold to be effective. In many counties the fastest selling lot is the "rural estate" or "ranchette". Also, there is an increase in public service costs associated with this type of development—school busing is one.

Increases in lot size as a farmland protection tool have to be in the 20- to 50-acre range to work well. These lots are still not adequate to farm, unless the operator moves to high value specialty crops. It is possible that even at these large lot levels conversion actually is being promoted. Parcels in the 25- to 50-acre range are perfect for subdivision and appeal to the investor or speculator who expects the zoning to break down over time.

Allocation. There are two ways to meet demand for rural housing and save farms. First is to allocate building rights on a formula of one house per 50 acres or so. This house can be erected on a 1-acre lot. Ordinances of this type survive exclusionary zoning challenges since the right to live in the country is not based on the ability to buy 50 acres. Another way around the large lot problem is the cluster provision. Under this system, land earns a DU right in rural areas at a high level, perhaps one house per 5 to 20 acres. Lot size usually is set by the need for a septic field and usually falls into the 1- to 2-acre range. A cluster provision allows the development of rural lots, but sets aside the bulk of the farm in an undeveloped status. Usually the developed lots are clustered on 10 to 20 percent of the land. The political acceptability of the land use control is improved with cluster provisions by providing an outlet for developmental pressures. Developers like cluster provisions since the cost of roads and other site work is reduced. A series of small neighborhoods is created instead of houses strung along the highway.

Cluster concepts can be improved on for the purposes of farmland protection. A number of Wisconsin counties require that the clustered home go in on Class II or higher land so that the prime soils are protected. Sliding scale zoning requires each DU to be earned at a higher land level—the first DU at 5 acres, then 10, then 20. This protects the largest farms, while still allowing a reasonable development return from the land. Most of the development goes in on land that is too small to farm.

The supply of nonfarm rural building lots creating large lot, or sliding scale zoning can be staggering. Even simple programs such as a plus-one system that gives each farm a single 2-acre lot will create hundreds of scattered lots. The potential for land use conflict with farming rises. Cluster and density allocation programs are better than large lot zoning alone, but are still far from adequate.

Taxation. Many communities use value taxation to protect farmland. The farmer gets a tax break on real estate taxes. There are countless problems with this. In rural areas the bulk of the local taxes comes from farms; thus, the revenue of the community falls unless the state makes up the shortfall. Real estate taxes are not a major cost of farming so the effectiveness of this cost control measure is not great. It will keep few farmers in production.

Even with a rollback (repayment plus interest) on the tax break, the use value provision of most Maryland counties encourages speculation somewhat by reducing the out-of-pocket cost of holding land. In most cases, land sale contracts call for the buyer to pay the tax, to avoid having the tax subject to real estate commission and transfer taxes. Use value with a rollback can be improved as well. Some states require the use value applicant to file a farm income tax form to be eligible. Others require that a percentage of the total income for the year be farm income to be eligible for the tax break. Wisconsin ties the break to a ratio of real estate taxes to total income for those who file a schedule F and limits the tax break to those in farmland preservation areas.

Zoning. The concept of agricultural zoning in many counties needs to be reviewed. Farming needs to be given protective status as is done in Montgomery and

Baltimore counties. The farmer is specifically allowed to keep livestock, operate farm machinery, apply agricultural chemicals, and till the soil without nuisance complaints from nonfarm rural neighbors. A number of counties require nonfarm residents to maintain fences between themselves and the farms around them. Effective right-to-farm legislation should be part of all efforts to protect agricultural lands.

Perhaps the best of the agricultural zoning ordinances lies in exclusive agricultural use. This concept says that farming and residences tied to a farm are the only permitted use. Most agricultural districts are really agricultural and residential areas—both are uses by right. Care must be taken to allow feed mills and other support activities in agricultural zones if the ordinance is to work. For example, a number of Wisconsin counties now use a series of agricultural zoning categories to meet the range of needs found within their jurisdiction. Typical agricultural districts include

- A-1 Hobby Farm—a "spot zone" for such things as kennels, stables and small orchards. While essentially residential, these areas meet a need and can be a buffer zone or a user of small parcels, which exist in and around prime farmland. No further subdivision of the lots is allowed in these areas.
- A-2 Transitional Farmland—areas that can be developed when urban services or demand or both reach the area. The goal here is to prevent premature and low-density subdivision. The courts usually have upheld holding zones, if the community adjusts real estate taxes and holds to urban service schedules that are reasonable. This category would see heaviest use in Montgomery, Anne Arundel, Howard, Charles and Carroll counties where over half the land conversion takes place.
- A-3 Long-Term Agriculture—a zone with rights and responsibilities conveyed to farms. Severe development restrictions are imposed and coupled with financial incentives to stay in farming. Erosion protection and significant subsidies to finance conservation measures should be required in these areas to protect the soil.

Demand Control

Regulations to protect farmland can be coupled to planning and zoning measures that reduce the pressures for land development. With this coupling, there are a number of actions that would be supported by the development community and by home buyers.

Contemporary planning and zoning are built around concepts found in the *Ambler vs Euclid* case about 50 years ago. Until recently it was the only Supreme Court case dealing with zoning. The Court upheld the right of communities to regulate land use through exercise of police power. Implicit in this case are the planning concepts of separation of land uses to prevent conflict and grave concern over residential density. Today, most codes create a situation where people live in one place, work somewhere else, and shop or recreate in another. Codes generally do not reflect standards based on performance and the ability of good design and engineering to overcome potential hazards. The single family detached unit is still the standard in most communities.

"The pressures to convert farmland can be reduced by increasing the supply of land through good design."

Design Issues. The pressures to convert farmland can be reduced by increasing the supply of land through good design. Most developers prefer to develop at higher density ranges. The real profit for most builders is in the structure, not in the land. The more structures, the higher the profit. Also, the cost of land improvements (streets, utilities and grading) fall on a per-unit basis when density increases, increasing the profit margin. However, most community groups oppose the development of high-density areas and with considerable success. It is hard to get property rezoned to higher densities. Citizen groups generally take the view that reduction in density reduces population growth. On a neighborhood basis, this may be true. Regionally, low-density areas spread people out, driving up the cost of public services. It is easy to see that 1/2-acre lots require half the land that 1 acre requires and that 1/4-acre lots use only a fourth of the land per dwelling unit. Single family detached homes can be built at six units to the acre with careful design. In fact this is the old standard city lot of 60 by 120 feet.

The same advantages to multiple family units exist. Row houses allow 8 to 12 units and stacked garden apartments run 18 to 22 units to the acre. As land required per household falls, pressures to convert farmland are reduced. Since only about 20 percent of households are traditional mother, father and children units, the emphasis on single family detached units may be misplaced. If a high-density area does not sell, it will not be built. The tight supply of high-density residential land reduces the buyer's option and boosts costs. Even when high-density areas are zoned and sited, usually there are losses during site plan approvals. It is rare to get four

houses per acre on land zoned for 1/4-acre lots. The same is true for multiple family units. The average actual density runs about 75 to 80 percent of the permitted density.

Much of this 20 percent density loss comes about in gaining site plan approvals. The public (reasonably) gets to comment on the design including density levels. To gain approval the developer points out that instead of 300 units, he or she is only going to build 260. The lost 40 units are displaced to 10 acres of former farm some place else within the market area. It is just possible that the land cost per dwelling unit also climbed by 20 percent for the units that were built. For 1/4-acre lots, this could be $4,000 a unit. Another source of loss occurs when density calculations are net of flood zones and roads or other open space. Thus a 100-acre, 1/4-acre zoned site with 10 acres of flood plain and 10 acres of roads would earn only 320 dwelling units rather than 400 units. The remaining 80 units are displaced to 25 acres of farmland somewhere else.

Failure to provide urban services is yet another source of land pressure. Crofton, Maryland is an example. Market pressure continued despite an 8-year sewer moratorium. While the community waited for Federal funds to upgrade a sewage plant that it should have planned for years earlier, large lots were developed in the place of small lot subdivisions. The small lot developers who waited were greeted by a school capacity moratorium created by the kids in the houses of the people who bought the large lots. Examples of similar density reductions resulting from road capacity limits can be cited.

Finally, land lost to highways is another area of pressure on farmland. While population growth is a factor in traffic generation, most of the recent traffic growth is tied to per capital use of the automobile. The two-career family, a high percentage of the population of driving age, and rising incomes play the major role in trip generation—population growth does not. Traffic could be reduced somewhat if mixed use was encouraged in land use planning. Shopping would be part of residential developments as should offices and employment centers. The same is true of entertainment, which accounts for about 10 percent of all trips. Mixed use has some potential for reducing the land lost during urban development.

Great land savings are possible through better parking standards. Parking is a major user of land in retail and office projects. Each car requires 300 to 350 feet of space at each destination. In other words each car demands 2 to 3 spaces scattered around the county. Developers pay about $1,700 for each surface parking space and $7,000 to $9,000 per space for structured parking.

Careful land use planning and mixed use development can cut the amount of parking. Usually called shared parking, the idea is to mix different land uses, which have separate peak parking needs. For example, a sports stadium requires great parking lots. Use of these spaces in the stadium's off hours maximizes the use of the lot. The same is true of offices and retail. Shopping is primarily an evening and weekend activity. A mix of offices around the edge of a shopping center works well. For example, Baltimore has movie theatres and a community college in an office area parking ramp.

Tax policy can encourage structured parking somewhat. Structured parking currently adds to a building owner's real estate tax. In fact, citizens should encourage the use of structures since each deck increases the supply of land. There may be reasons to exempt parking structures from the tax base—most of the value will be recaptured in the offices anyway. The pressures on urban land also could be reduced by forcing the owners of land in the path of development to convert their property. At any given time, only a small portion of the land that is "ripe" for development is on the market. Much of the "leapfrog," which drives sprawl, is tied to land owners who are holding for appreciation. Real estate tax policies should be based on active reassessment of land served by urban services. The full value of these services could be assessed against the owner to force conversion. The capital cost of roads, schools and sewers serving vacant land must be staggering.

Urban Service Planning. A significant amount of conversion of farmland is caused by poor planning and coordination of urban services. Failure to provide sewage treatment plans leads to low density development on well and septic systems. In most landscapes, septic systems require a minimum lot size of at least an acre. Often one-third to three-fourths of the land cannot be developed with septic systems leading to scattered developments, which break up the land and make farming difficult.

No more than 10 percent of new home construction should be on septic systems. Maryland falls in the 40 percent range. Septic systems inevitably fail, which is a major reason to discourage their use. Sewer extensions need to proceed in advance of growth. It should not take 6 years to plan and construct a pump station. Urban services have to be built in anticipation of boom years and carried during the down times. Coordination of schools and roads needs to accompany infrastructure improvements. Graceful accommodation of growth is at the heart of planning.

Sewers should not run across quality farmland. Wisconsin requires an agricultural impact statement on all state projects. Maryland currently is serving vast land areas in the process of serving beach communities built on well and septic systems. Southern Anne Arundel land is being opened for development as a result of the sewer systems.

Agricultural Enhancement Programs

Most of the public effort to protect farmland has gone to land use controls and tax breaks. To be effective, farming has to be a viable economic activity. It has to be able to pay its own way. In addition, agriculture needs to be protected from inappropriate encroachment. Pressure on farmland can be reduced by 20 to 50 percent through public growth policy without driving up the price of housing. Simultaneously, farm income must be increased through technical assistance programs that are based on the agricultural needs of the 1990's. Unfortunately, much of federally financed agricultural assistance is aimed at export crops and large farms. It is clear that national agricultural health cannot be based on large farms, high debt service, and emphasis on cash grains. This type of agriculture is even less appropriate in Maryland's urban shadow.

Most farmers learn an agricultural operation from their parents. However, to remain viable, today's farmers must be willing to make changes. Most of today's small farms need to be replanned as businesses. Greater crop diversity is needed to flatten peak labor demand and cope with climate and market fluctuations. Higher value crops are needed to replace cash grain or beef grazing. These changes require new agricultural Extension agents who can work with farmers and ease them into direct market crops, nursery stock and other crops that are better suited to smaller farms with part-time operators. Assistance is needed in the areas of financial management, crop selection, production and marketing. Currently, agricultural agents and Soil Conservation Service personnel often are traditional agriculturists by training or habit. Often they feel more comfortable with either high-tech farming or with the older farmers of the community. Areas are abandoned to urbanization by these support staff. In some cases the productivity measures for these agents are based on acres treated or other formulas, which run against the small operation typical of the urban fringe.

Recently, the State of Virginia explored the area of market enhancement as part of a combined effort to help farmers and strengthen employment in rural areas. The concept was to create a venture capital fund to develop industries that would buy rural products as an input to manufacturing. Examples of this type of activity include a drying kiln and mill that produce hardwood trim and doors; a bottling operation that produces a nonalcoholic sparkling grape juice; a mushroom farm that grows Chinese mushrooms; and an operation that raises pheasants and quail for the restaurant trade.

The desire for fresh produce, a demand for a wider variety of fruits and vegetables, and an increase in gourmet cooking create a market for this type of agricultural development. Maryland has a fairly active farm market movement and has a massive wholesale food market in the Baltimore-Washington corridor, which needs to be more fully exploited. Another example, New York State, has a "buy New York" policy for state food purchases. Hospitals, prisons, schools and universities constitute a large market that can aid social development.

Summary and Recommendations

Maryland can protect its agricultural heritage and its food producing resources. There can be a positive future for Maryland agriculture. That future will not be found in efforts to return Maryland agriculture to the past. Efforts must be directed toward establishing a self-supporting agriculture, which can be environmentally and economically sustained. The state and its local units of government can be effective in promoting a context for change and prosperity. First, however, farmland protectionists have to understand that land use regulations alone will not protect farmland. Regulation cannot fly in the face of economics. The proper role of regulation is to prevent the worst from happening—it rarely results in optimization.

Great strides can be made in planning and zoning, and in reducing the pressure on farmland in rural and near urban areas. Far too much land is tied to the speculative process. Better planning of public services, increases in density and a more orderly development pattern could cut housing costs and keep land in farming much longer. State and local planning departments need to monitor and project growth and land needed to allow the private sector to more accurately forecast land needs.

"Effective right-to-farm legislation should be part of all efforts to protect agricultural lands."

Great efforts need to be made in getting the public to understand high-density development. An awards program for excellence in design should be established. Model zoning texts and sample subdivisions could be developed. Statewide targets for acceptable lot size are needed. A good target for many counties should be a 1/4-acre-per-dwelling-unit average. No more than 25 percent of the state's residential development should go on well and septic developments and 10 percent is a better target. Finally, preservation programs should be targeted by specific areas. Public support for preserva-

tion often is tied to feelings that the public has had all the growth it can handle. In these urban counties it is very hard to do permanent protection except in the 100-year flood plain. What is needed is an orderly transition from farming to urban uses in these areas.

In stable rural areas the bulk of the productive capacity of the state must be protected. Farmland protection in these areas reinforces the agricultural basis and provides a secure environment for continued investment in farming. In many areas it is not clear whether the area is past saving or will remain farmland. The sprawl zone also needs programs. Perhaps this is the area where greatest effort is needed. Failure to act will cause permanent loss of land. Efforts are more likely to be effective here than on land closer to the cities.

The process by which farmland is converted to urban uses must be better understood. There are almost no studies of urban fringe and tenure. How the agricultural community adjusts to urban pressure is not known. Successful urban fringe farms should be studied to provide models. In addition, good land information must be provided to the real estate community if the market is to function well. Most communities do not have good numbers of the supply of land available for development. Information on lots in the development pipeline allows developers to avoid overbuilding. Efforts should be made to ensure enough land in basic use categories to allow the market to function. When supplies exceed this level (a 3- or 4-year supply), citizens should be able to postpone subdivision.

Finally, farmers could use a dose of reality therapy. Farmers cannot expect public assistance during the farm years and the opportunity to be land speculators when opportunity strikes. Farms, like other businesses, need to be run well. Those who do not have management skills will be pushed out of farming, just as poor managers are pushed out of small shops and restaurants. Likewise, farmers have been largely exempt from regulations dealing with soil loss and wetland conversion. Maryland farmland plays a major role in the state's water quality problems. There is great public benefit to programs that could protect the farms, the soils and the state's water in an integrated fashion.

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Maryland's Disappearing Farmland

Roland E. English, III

Maryland is comprised of cities and people, farms and forests, commerce and industry, vacation and recreation resources, historic and cultural resources, and natural habitats and mountains. Maryland's diversity is an important asset, an asset to be preserved for future generations. However, the needs of agriculture and forestry are competing with the demands of growth.

Farms and forests in Maryland are disappearing at an unprecedented rate. The scattered pattern of low density growth is a strong threat to both. Unfortunately, state and local resource protection programs are not protecting enough agricultural and forest lands, current land use plans are not always implemented, and these plans fail to direct much of Maryland's growth. Maryland must balance growth against resource protection.

Growth Trends

Maryland's growing population will continue to need new houses, new schools, and places to shop and recreate. Maryland's growing economy will continue to need new areas for employment, as well as commercial and transportation activities. The type and location of development, as well as its mere existence, has an impact on the land resources of the state's agricultural industry. Wise decisions about the location, the type of development, and the protection of the state's resources can be made only by understanding growth and development factors, and through careful consideration of future impacts. Following is a summary of key population, housing, and development trends affecting Maryland.

Maryland's population is growing rapidly.

Maryland's population increased 8.6 percent between 1980 and 1988 and is projected to expand 20 percent more by the year 2020 (Figure 1). Almost all of this increase will take place in the 11 central and southern Maryland counties. Immigration will be a key element in the state's increasing population.

Household growth is faster than the population growth.

The number of households increased 20 percent over the past 8 years with an additional 32 percent expected by 2020 (Figure 1). Household formation at 1 1/2 times the rate of population growth will greatly increase the demand for housing.

Land will be developed at a rate even faster than household growth.

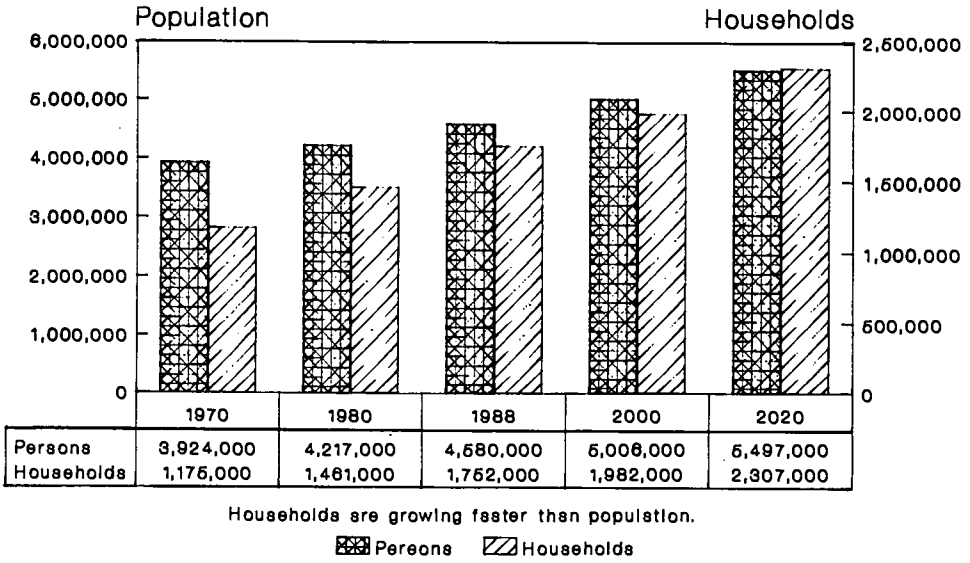
In 1980 there were 806,500 acres of developed land. Eight years later, there were 892,400 acres of developed land. At the current density level, the number of acres developed by 2020 (an estimated 1,106,700) will be 53 percent greater than at present. Land development is taking place at 2 1/2 times the rate of population growth and almost twice that of household growth (Figure 2). These projections reflect a growing problem that increasing amounts of land are being used per dwelling for single family houses.

A small portion of single family residential housing is consuming a disproportionately large share of the land.

Information for 1987 demonstrates the emerging large residential lot problem. At that time, 11.5 percent

Figure 1.

Maryland Population and Households 1970 to 2020



	1970	1980	1988	2000	2020
Persons	3,924,000	4,217,000	4,680,000	5,006,000	5,497,000
Households	1,175,000	1,461,000	1,752,000	1,982,000	2,307,000

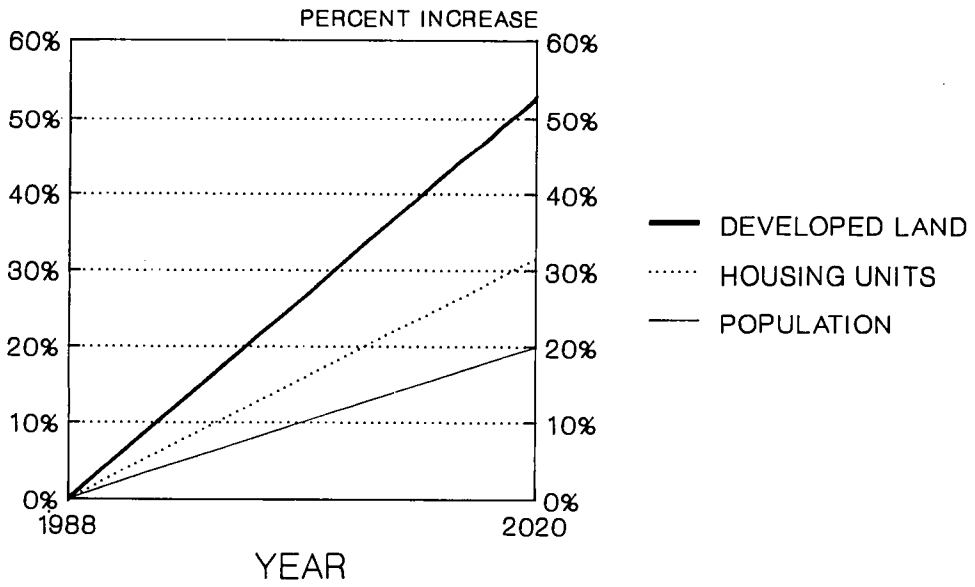
Households are growing faster than population.

Pereons Households

Department of State Planning

Figure 2.

Land Consumption Exceeds Population Growth



Maryland Department of State Planning

of all existing single family homes in the state were on lots of one acre or more, but in new construction, 17 percent of the houses were on large lots. The average size of these new large residential lots is over 3 acres.

The localities most affected by large lot development are in outlying areas that ring the metropolitan area and include portions of Cecil, Harford, Baltimore, Carroll, Howard, Frederick, Calvert, Charles and St. Mary's counties. The increase in land development from 1970-1988 can be seen in Figure 3.

Land and housing values foster low density development, particularly in the outlying and more rural areas.

Developed lots of over 1 acre in the rapidly growing sections of the metropolitan area have market values averaging 45 percent higher than large developed lots of over 3 acres in the outlying areas that ring the metropolitan area. Even lots of less than 1 acre in the metropolitan area exceed the large lots in the outlying areas in market value. This allows the significant number of instate migrants to move from dense, small lots to low density, large lots at no increase in cost or, in other words, to acquire more land per dollar. In the rapidly growing sections in the metropolitan area, the average value per acre of improved residential land is $207,700 compared to $49,400 per acre in the outlying ring areas (Figure 4).

Impacts on Agriculture and Forestry

The scattered pattern of Maryland's growth threatens the land resources required to sustain viable agricultural and forest industries. In addition, dispersed large lot development is threatening the state's open space, natural areas and environmental health.

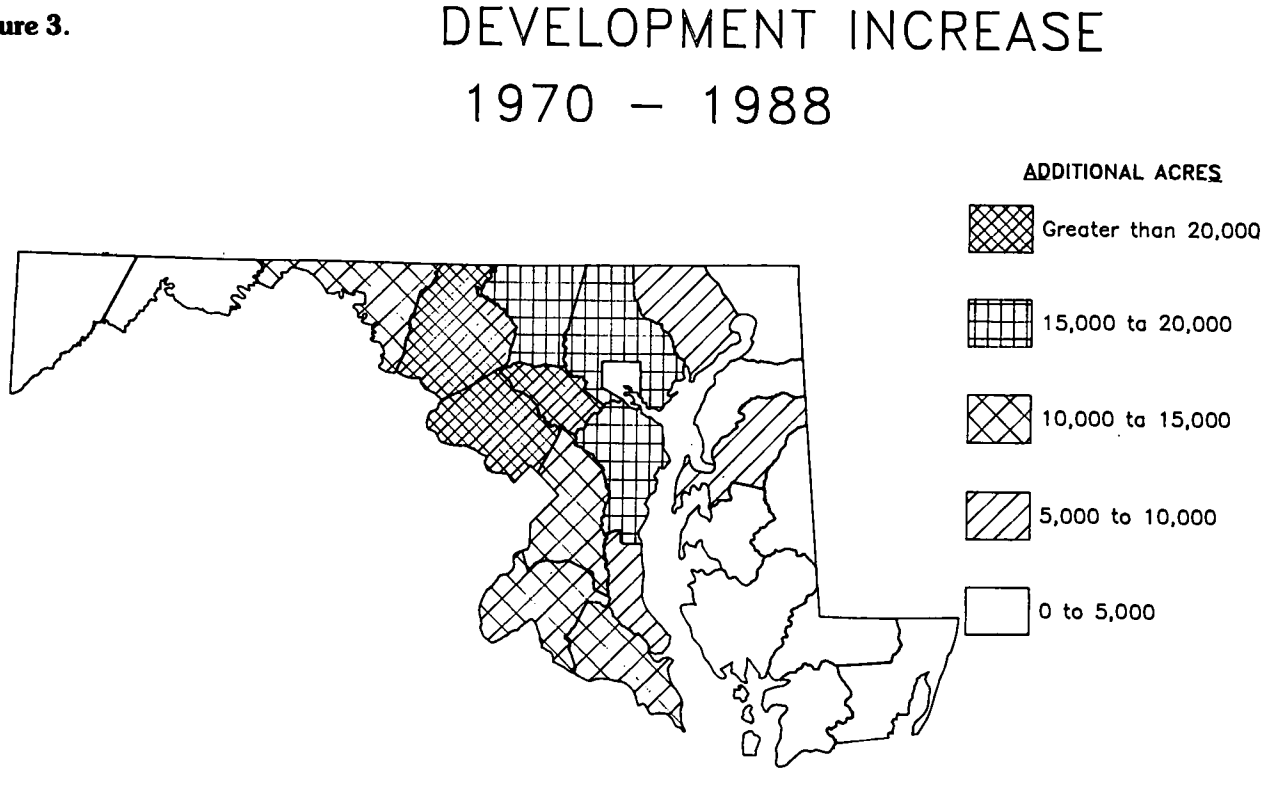
Agricultural land is being lost at an unprecedented rate.

Between 1973 and 1985 agricultural land in Maryland declined by 56,200 acres of which 55,100 acres were used for development. Maryland currently has 2,478,000 acres of agricultural land. By the year 2020, at current development rates, agricultural acres will decline 9.1 percent to a total of 2,269,000 acres.

Forest land also is being lost at an unprecedented rate.

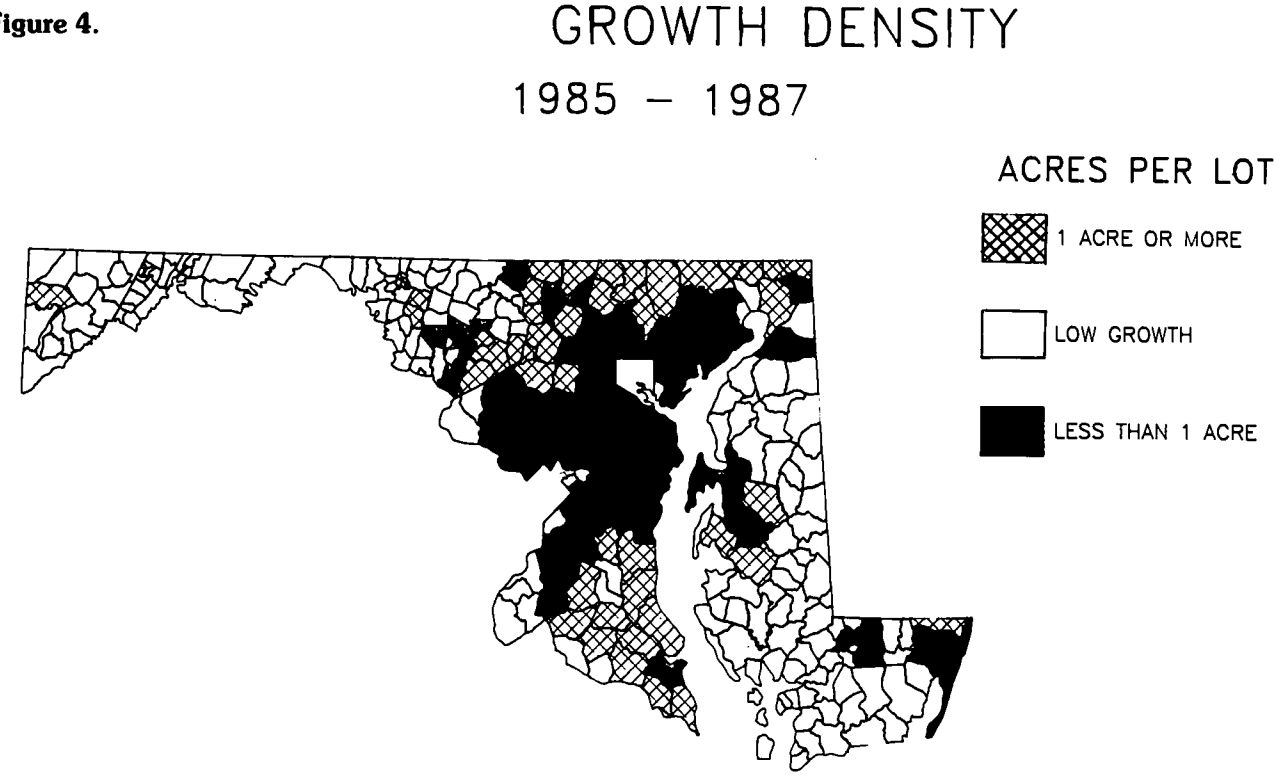
Between 1973 and 1985 Maryland experienced a net loss of 55,000 acres of forest land. Statewide forest land provided 40,000 acres of land for new development with the remainder being cleared for new agricultural uses. Currently, Maryland has 2,677,000 acres of forest land. At current development densities, forest land will decline 243,800 acres by the year 2020 to a total of 2,443,500 acres.

Figure 3.



Source: Maryland Department of State Planning

Figure 4.



Source: Maryland Department of Stote Planning

The increasing rate of large lot, residential growth will cause an even greater loss of agricultural and forest land.

Should development densities continue the pattern of decline (low density), the amount of agricultural and forest lands converted by the year 2020 would be 675,000 acres. Agricultural land would decline 325,000 acres; forest land would decline 350,000 acres by 2020 (Figure 5). Total agricultural land would be 2,153,000 acres, and forest land would be 2,327,000 acres.

Low density development is threatening the "critical land mass" required to sustain Maryland's agriculture and forestry.

Maryland currently has 2.3 million acres of agricultural land that has prime or productive agricultural soils. To maintain the current capabilities of the industry, these key acres must be maintained for agricultural use. The American Farmland Trust (AFT) estimates that the critical mass of agricultural land in Maryland is 2.0 million acres (cited in *Agricultural and Forest Land Preservation in Maryland,* Department of State Planning, 1983). Development on agricultural land, between now and the year 2020, will deplete key prime and productive agricultural land and approach the critical level of 2.0 million acres. Prime and productive forest soils cover 2.6 million acres. According to the AFT the critical mass of land to sustain the current forest industry is estimated to be 2.4 million acres. Development on forest land is already reducing the remaining prime and productive forest land, and continued development between now and the year 2020 could easily reduce forest land to 2.3 million acres.

To maintain the critical mass of both agricultural and forest lands, Maryland must alter the current rate of development. Based on yield trends, consumption trends, and U.S. Department of Agriculture per capita growth rates, preservation goals for agricultural and forest lands are listed in Table 1.

Encouraging high density and less fragmented patterns of development is the key to protecting Maryland's agriculture and forestry.

Developing residential land at slightly higher densities would greatly reduce the additional land required for new development. Higher density growth would mean that only an additional 256,000 acres would be converted by the year 2020, instead of the 675,000 acres that the emerging trend of increasingly lower density sprawled development would absorb. Assuming the higher density growth to be the 2020 goal, agricultural land and forest land critical masses could be maintained

Table 1. Preservation goals for agricultural and forest lands

Region	Acres of agricultural land	Acres of forest land	Total
Eastern Shore	980,000	675,000	1,655,000
Piedmont	650,000	495,000	1,145,000
Southern Maryland	195,000	650,000	845,000
Western Maryland	135,000	600,000	735,000
Total acres in Maryland	1,960,000	2,420,000	4,380,000

with a reserve of 333,000 acres for post-2020 development. Low density growth would require all of this reserve plus an additional 83,500 acres of critical agricultural and forest lands (Table 2 and Figure 4).

Existing Preservation Techniques

The State of Maryland and its local governments have shared the responsibility for protecting agricultural and forest lands. Local land use policies and plans should be the most practical method of controlling the conversion of agricultural and forest lands to developed uses. However, the key is effective and consistent implementation of zoning, and the provision of services such as water, sewer and roads to areas designated for residential development. Local Purchase of Development Rights (PDR) and Transfer of Development Rights (TDR) programs, in which a land owner receives a payment for giving up the right to develop his or her property, also should be integrated into a coordinated local preservation effort. The Maryland Agricultural Land Preservation Foundation should focus on protecting the critical land mass needed for the agricultural and forest industries. State Use Value Assessment and the Agricultural Transfer Tax should be used to help preserve farm and forest acreages. State and local preservation techniques must be better coordinated and more effectively implemented.

Table 2. Land use in 1988

Land use	Acres
Development	
Very low density residential	164,000
Low density residential	242,000
Medium and high density residential	289,000
All other development	197,000
Total development	892,000
Resources	
Agriculture	2,478,000
Forest	2,677,000
Extractive and barren	23,000
Wetland	245,000
Total resources	5,423,000
Total land used in state	6,315,000

Plans for land use are not effectively implemented, and fail to protect agricultural and forest land.

Most counties have agricultural zoning in principle (Table 3). However, they permit residential development to some extent on land in agricultural zones. However, unless the residential density is so low that it will not interfere with farming, the land is essentially unprotected. In fact, the requirement of a minimum density for the residential use of agricultural land often influences a developer to use more acreage than he or she otherwise would have done, thus resulting in conversion of even more agricultural land.

Planned and existing areas with sewer and water services are not effectively capturing new development.

Maryland currently has almost 229,000 acres of vacant land with available sewer service. Another 312,000 vacant acres are planned to be sewered within 10 years. These 541,000 acres are twice the number of additional acres needed for higher density growth (256,000 acres) more than the additional growth at current trends (467,000 acres), and a large portion of the land required by the year 2020 for sprawled low density growth (675,000 acres). And yet in 1987 almost 40 percent of all new units were built outside areas with available sewer service. These septic units have larger lots and are widely dispersed, and were converted from 80 percent of the land used for new residential growth.

State and local PDR and Fee Simple Acquisition programs are not keeping pace with the rate of growth and development.

Table 3. Agricultural zoning in Maryland

County	Acres per dwelling	County	Acres per dwelling
Allegany	1	Harford	10
Anne Arundel	20 (net 3)	Howard	3
Baltimore City	n.a.	Kent	2
Baltimore	50	Montgomery	25
Calvert	5	Prince George's	2
Caroline	2	Queen Anne's	8
Carroll	20	St. Mary's	1
Cecil	5	Somerset	1
Charles	3	Talbot	2
Dorchester	1	Washington	1
Frederick	(3 lots/ parcel)	Wicomico	.5
Garrett	n.a.	Worcester	(3 lots/ parcel)

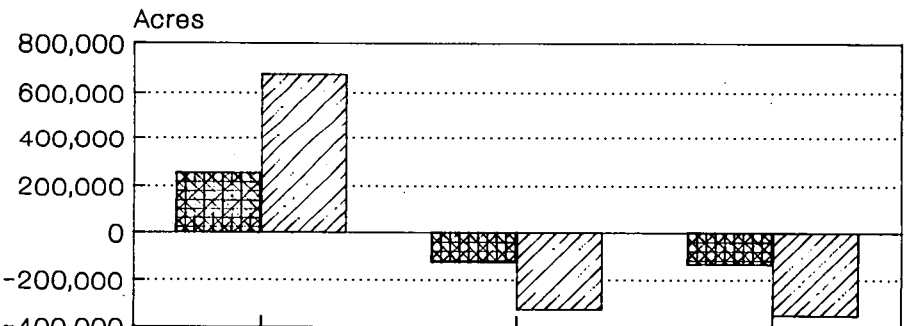
The Maryland Agricultural Land Preservation Foundation, combined with the few counties with local PDR programs, has protected 150,000 acres in agricultural districts, and has purchased the development rights on one-half of those acres. Although the Maryland program is the most successful in the country, it has only protected 0.75 percent of the critical agricultural land mass. While forest land is eligible under the program, the emphasis remains on farmland. Approximately 450,000 acres of forest land are in public ownership, or 18 percent of the critical forest land mass. To keep pace with the rate of development between now and the year 2020, state and local PDR and Program Open Space acquisition must be 15,000 acres of agricultural land per year at a minimum and 21,000 acres of forest land per year to keep pace with the anticipated very low density growth rate.

State agricultural use value assessment and the agricultural land transfer tax have not reduced the pressure to convert farms and forests.

Over 3.5 million acres of agricultural and forest lands receive the benefits of lower property taxes as a result of use value assessment. Approximately 2.1 million of the use valued acres are agricultural and 1.4 million acres are forest. If this land is sold to be used for nonfarm or nonforest purposes, the seller must pay the Agricultural Land Transfer Tax. Between 1982 and 1987, 110,000 acres of land were converted and subject to this tax (Figure 6). In 1988 over 44,000 acres of land were converted out of use value, a very strong indicator of future development.

Figure 5.

Land Use Change: 1988 to 2020
Change in Acres



	Development	Agriculture	Forest
High Density	256,000	-124,000	-132,000
Low Density	675,000	-325,000	-350,000

Projections based on residential development.

High Density Low Density

Maryland Department of State Planning

Figure 6.

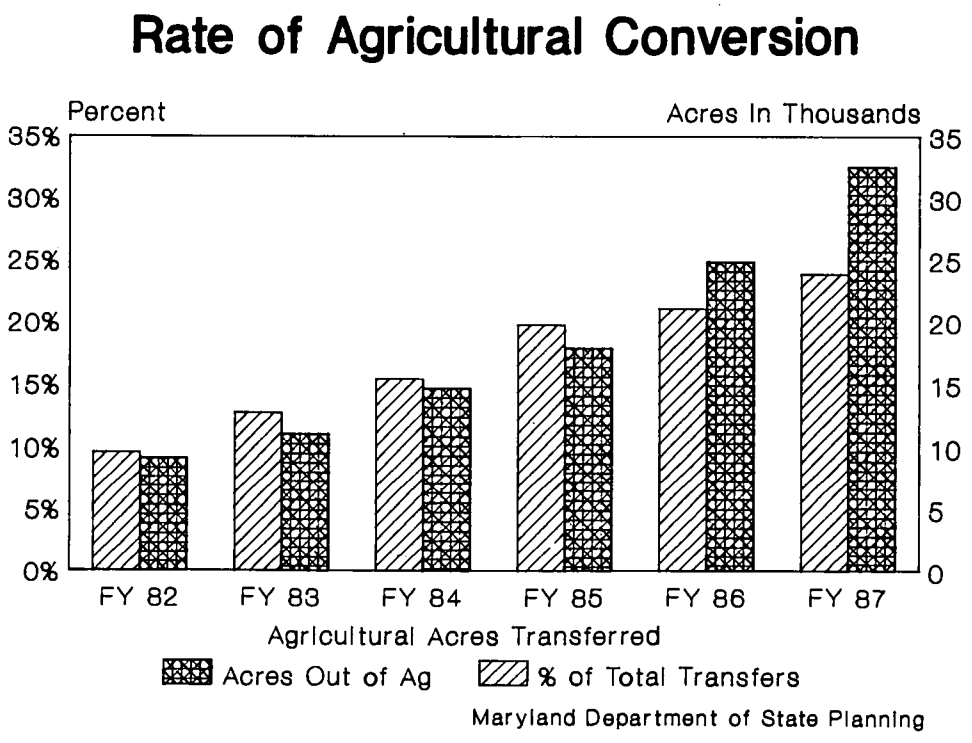


Table 4. Eight steps for improving land use[1]

1. *Improve and strengthen land use planning.*
   Plans should forecast the amount of land needed for growth and be implemented directly by zoning and water and sewer service plans. Strengthened and integrated local plans should be monitored continually for implementation effectiveness and systematically updated.

2. *Concentrate development and prevent sprawl.*
   Residential development should be encouraged in areas that maximize use of public services. State financial assistance should be linked to effective growth management and resource protection.

3. *Enact effective agricultural zoning.*
   Effective agricultural zones (more than 20 acres per residential unit) should be enacted. Zoning for residential areas should be at no more than 1 acre per unit. Agricultural and residential uses should not be intermingled.

4. *Provide zoning for dense residential development.*
   Zoning ordinances and an inventory of land used for development that provide for a variety of housing types and densities should be developed. Zoning provisions allowing clustering, and development programs that encourage good site planning and design should be integrated into the overall development approval process.

5. *Provide funding for the public infrastructure.*
   The inventory of land suitable for development should be increased. Funding or the public infrastructure that supports growth also should be significantly strengthened.

6. *Redirect growth into existing urban areas.*
   Infill and redevelopment should be increased by using density bonuses or financial incentives.

7. *Continue programs for conservation and preservation.*
   Continue and adequately fund programs that conserve and preserve the land resources of the state. Target existing programs for maximum benefit.

8. *Coordinate programs for conservation and growth management.*
   Programs for conservation and preservation should be linked to growth management. Local and state plans should be integrated and deal with both land resource conservation and with ensuring the appropriate development of the state.

[1] Paraphrased from "Land Use or Abuse?", Maryland Department of State Planning, December 1985, pages 24, 25 and 26.

Existing state and local preservation techniques are not sufficiently effective.

Agricultural and forest lands often are depicted in plans and zoning maps as interim uses or development reserves. Approval of subdivisions and issuing of building permits do not reflect the agricultural and forest preservation policies of local governments. PDR programs are voluntary and protect land in a scattered pattern. It is important to continue a certain amount of farming within a reasonable radius in order to make it worthwhile for the necessary farm service and supply businesses to operate. Local TDR programs seek to protect communities but exist in only three counties, and work only when the demand for new housing is extremely high. Payment of the agricultural transfer tax does not stop development, but does help fund the preservation program. Protection efforts must be more focused.

Agenda for Action

An important goal for all Marylanders is to maintain the diversity of their state while meeting the often conflicting demands on land resources. How will citizens continue to meet human needs, protect the environment, conserve their significant natural and cultural resources, and allow the efficient provision of public services? Strengthening land preservation and improving development practices will require concurrent initiatives by the state and local governments to achieve the growth policies and their desired results (Table 4).

Conclusion

Even though Maryland has some of the more successful land resource protection and growth management programs in the nation, the rapid expansion of low density development requires that plans, programs and policies be re-examined. The challenge is to develop positive actions for the continuation of the successful heritage of Maryland, its counties, its cities and, most importantly, its people.

Economic Development and Rural Development

William W. Falk and Kurt Finsterbusch

Introduction

The Governor's Conference on Agriculture is one of a growing number of national conferences that focuses attention on agriculture and rural areas. And while this particular conference is largely concerned with land use and issues related to agricultural production, economic and employment issues must not be overlooked.

Although the following discussion will not be about agriculture as such, much will touch on farmers. Even without the current demand for agricultural land in those Maryland counties closest to large urban areas, farming has been in a state of change for a long time. Drought, farm finance and the farm crisis have, in recent years, caused Americans to be even more aware of farmers and their families. At present, over 70 percent of farm families are dependent on some form of off-farm employment. Also, the trend toward dual-earner families so characteristic of urban areas has found its way into rural areas as well. Although today's farmers are somewhat different than those of 20 years ago, like all other rural residents they worry about the future of their counties and communities. In the face of so much urban growth and the intrusion of urban folk into rural areas (especially through tourism), what does the future hold for rural areas? Will the rural way of life disappear from the landscape? Or can steps be taken to preserve its unique place in America's heritage? Steps can be taken, but more planning than currently occurs is required, especially in the development of a more diverse economy in rural areas.

Economic development in rural Maryland has many aspects and implications. However, this discussion will be limited to two areas. First some general information and impressions about rural Maryland will be presented, followed by a brief description of some problems encountered and economic development strategies used by rural communities attempting to attract new industries. Both issues are important since Maryland, according to one estimate, spent around $40 million last year in the industrial recruitment game.

Second, findings from a study on economic development on the Delmarva Peninsula will be discussed. Examples in the study demonstrate how communities geographically close to one another are worlds apart when it comes to encouraging or discouraging economic growth. Finally, critical questions are raised about the future of Maryland's rural and agricultural communities.

Maryland—An Enigmatic Place

Maryland is a schizophrenic place. In reality, Maryland is both northern and southern; rural and urban; developed and undeveloped; friendly and aloof; in a hurry (especially on its 55 mile-per-hour highways) and laid back. These qualities are rooted in the divergence between life in the Baltimore–Washington corridor (where nearly 80 percent of Maryland's residents live on 20 percent of the land) and life in the remaining 80 percent of the state where about 20 percent of the people live. The corridor is really "urban" Maryland, not the Maryland of scenic beauty typically catalogued in travel brochures and found outside of urban places.

According to Falk (unpublished data), Marylanders seem to be divided into four large geographic concentrations: (1) the District of Columbia labor market area,

"Rural places usually lack the economic base to sustain large numbers of new families. Often, as one presidential commission put it, rural areas are 'left behind.'"

which absorbs Montgomery, Prince George's, St. Mary's and Frederick counties as well as eight Virginia counties; (2) Baltimore, which draws on Baltimore City and such counties as Carroll, Anne Arundel and Howard plus one Delaware county and two Pennsylvania counties; (3) the Eastern Shore, which includes all Maryland counties there plus two Delaware and two Virginia counties; and (4) Western Maryland with its three Maryland counties as well as two from Pennsylvania and three from West Virginia. One also should note that Maryland offers employment for some nonresidents and residence for some people who are employed outside of the state.

Several speakers at the Governor's Conference on Agriculture have made reference to pressure on the land, especially agricultural land. However the pressure most often felt and observed, is either in or adjacent to the Baltimore–Washington corridor—in counties such as Anne Arundel, Baltimore, Frederick, Howard, Montgomery and Prince George's. But in Maryland, unlike many other urban states, demand for rural land is high close to and far away from urban areas. Farmlands in Delmarva and Western Maryland are being sold to developers in quantities that concern people.

Rural places usually lack the economic base to sustain large numbers of new families. Often, as one presidential commission put it, rural areas are "left behind." But this characterization does not seem to be as true in Maryland as it is elsewhere. Not all rural areas languish and there really is no reason why they should. Some strategies that states and communities have used around the country in attempts to attract new industry follow.

High Tech Aspirations, Low Tech Realities

Falk and Lyson (1988) discuss the typical strategies used by rural communities to attract new industry. Often this amounts to massive giveaways: tax abatements, free land, improvements made at local expense, buildings erected at local expense or heavily subsidized, state right-to-work laws, and so on. What may happen then is that these communities will try to outbid one another for a new industry. The net effect of this can be that even in attracting an industrial winner, a community may lose. Why? Because more is given away than is received.

The recent case of Kentucky's aggressive pursuit of the automotive parts industry is a good case in point. No one can say exactly what kind of mortgage was taken out to get this industry. The costs will not be fully paid for a long time, since the debt is amortized.

The usual mentality at work in local communities in the industrial recruitment game is "any job is better than no job." But just as there are no free lunches, it also is true that industries that receive considerable local fanfare are never cheap. They typically demand increased levels and quality of local services, which means that money must be generated from the local population (often through increased local taxes, ad valorem taxes, local bond programs, and so on). As other researchers have shown, there is a very disruptive, disadvantageous side to economic development in rural areas; a side most planners would rather ignore (see Gene Summers et al. (1976).

For citizens determined to improve themselves, they must remember that they need to improve and develop the community at large, not just the individuals in it. As Perry (1987) put it, fix up communities, not the individuals. Perry is not discounting the need to improve individual skills and abilities, but he recognizes that to compete successfully for new industries, local areas must improve their image in the largest possible sense—not just provide a better educated citizenry. This requires an improved quality of life in all dimensions, not just tinkering with a thing or two. Image improvement requires a very hard self-examination. Not only flaws are noted, but more importantly, areas of potential growth and development are identified. According to Perry (1987), economic development means more than business development. Schools, hospitals, banks as well as political bodies must be examined to adequately gauge a local area's strengths and weaknesses. This same point has been made in a new report issued by the National Governor's Association, **A Brighter Future for Rural America.**

For development to occur in the most positive way possible, there must be a kind of "development culture," which is recognized easily by both the new industry recruited from outside the community as well as potential local investors. Preliminary findings from Finsterbusch's (1988) study of development on the Eastern Shore support this contention.

Development in Southern Maryland and on the Eastern Shore

According to a field study by Finsterbusch and others (1988) there are dramatic differences in the economic circumstances of the 11 Maryland counties in Southern Maryland and on the Eastern Shore. They can be classified into three groups: (1) boom counties, (2) problematic counties and (3) choice counties. The boom counties include Calvert, Charles, Queen Anne's and Worcester. According to estimates by the Maryland Department of State Planning their populations will grow by 137, 110, 81 and 57 percent respectively from 1970 to 1990. The populations in the first three counties are booming because they are near urban areas while Worcester's is booming because of the huge growth in Ocean City.

In general, the boom counties do not have to create economic development. Their major concern is to control and manage the development that comes to them. Each of the boom counties, however, has booming areas as well as more remote, nonbooming areas where conditions are similar to those in the problematic counties. Booming areas also have economic problems because the influx of people is straining available services and making it necessary to raise taxes (a point made earlier about common outcomes to growth). In fact, Calvert and Prince Charles counties are aggressively promoting economic development to help with their tax burdens.

The choice counties are not experiencing booms but they do have locational advantages, which should make their development somewhat easier than for the problematic counties. The choice counties are St. Mary's, Talbot and Wicomico. They have 1970 to 1990 population growth estimates of 52, 22, and 35 percent respectively (Maryland Department of State Planning).

The choice counties do not have economic growth guaranteed as do the booming counties, but they should not experience economic depression even if they make no effort to develop. No matter what policy they choose (standing pat or aggressively pro-growth), they will have some economic success. For example, Talbot County is succeeding with little effort, while Wicomico County has been very successful with aggressive economic growth activity.

Each of the choice counties has special features or resources that more-or-less guarantee that the county will prosper. St. Mary's is close enough to metropolitan Washington, D.C. to be assured of some growth. The Maryland Department of State Planning projects a 34 percent population growth by the year 2005. Talbot is not expected to grow as much (about 14 percent by 2005) but it has attractive resort areas, more jobs than workers, and is within 1 1/2 hours of both Washington, D.C. and Baltimore. Furthermore, many social indicators are quite positive for Talbot; for example, its percentage of families below the poverty level is the lowest on the Eastern Shore. Finally, Wicomico is the major regional city for the lower two-thirds of the Delmarva Peninsula. Its only competition is Dover, about 50 miles away to the north.

It should be remembered that the categories of booming and choice counties apply to each county as a whole. While a county may be booming generally, individual businesses or sectors such as farming may be in serious economic difficulty. Leaders of successful counties, then, must be mindful of ways they can assist economically troubled sectors.

The problematic counties are Caroline, Dorchester, Kent and Somerset with 1970 to 1990 population growth estimates of 25, 2, 5, and 17 percent respectively (Maryland Department of State Planning). These counties are problematic because they are relatively remote from urban areas and have less appeal as resort or retirement sites. Instead of booming, they are in danger of declining unless they actively promote some form of development.

The four problematic counties generally have the lowest scores on important social indicators. For example, except for Baltimore City and Garrett County, the percentage of families above the poverty level in 1979 was lower for Caroline, Dorchester, Kent and Somerset than all other Maryland counties. The four problematic counties had the lowest average household income of the counties studied, generally high unemployment rates, and fewer jobs than residents seeking work.

The attitudes of leaders in the four problematic counties differed widely. Somerset and Dorchester County leaders recognized that their counties were not prospering and that actions had to be taken to improve their economies. They were not clear or united, however, about what they should do and how hard to pursue economic growth. In the past year they have become more active in trying to generate new jobs, but they still are not as aggressive in this as nearby Caroline or Wicomico counties. Somerset and Dorchester County leaders expressed greater ambivalence about economic growth because some kinds of growth might threaten the citizens' way of life or threaten struggling local businesses by raising wages for unskilled workers.

Caroline County leaders were much less ambivalent. In 1970 when Federalsburg lost many jobs because of the closing of some plants, town leaders built an industrial park and found industries to fill it. With their backs to the wall, the leaders aggressively sought to generate jobs. Caroline County leaders represent a success story to this day—they were motivated, they learned how to

recruit industries, and they succeeded. More recently Denton leaders have followed their model with great success, especially given that industrial recruitment has become so competitive recently.

Kent County is unique. It is a problematic county because its estimated population growth from 1970 to 1990 is only 5 percent, whereas Maryland as a state is estimated to grow 19 percent (Maryland Department of State Planning). Kent County also fares poorly when examining social indicators. On the other hand, many residents are quite comfortable, thus there is little incentive to aggressively push for economic growth. Farms are larger and more prosperous in Kent County than in all other Eastern Shore Maryland counties. Per capita income was $9,194 in 1981, which was the third highest of Eastern Shore counties, behind Talbot ($12,595) and Worcester ($9,486). In general though, the feeling in Kent among most county leaders (until recently) was to leave well enough alone.

"An economic development program must include activities that will change the negative perceptions and attitudes of residents."

Lessons Learned in Rural Maryland

Having surveyed the general economic landscape for Southern Maryland and the Eastern Shore, four lessons about rural economic development emerge from the study. The first lesson concerns the three strategies commonly used to generate more jobs: (1) economic development committees, (2) industrial parks and (3) shopping centers. (In Southern Maryland, developing office buildings and recruiting white collar businesses were also emphasized.) Other strategies included promoting tourism, renovating downtown areas, procuring grants and creating training programs.

Lesson 1: Industrial parks accomplish little by themselves.

An economic development committee (with a full or part-time director) usually participated in the development of industrial parks. When one did not, the industrial parks had few or no tenants. The most aggressive recruitment of industries for industrial parks was in Caroline and Wicomico counties—these were also the most successful parks in improving the counties' economies.

Successful recruiting of industries for parks requires time, effort and good recruiting techniques. According to Peters and Waterman (1982), "A simple summary of what our research uncovered on the customer attribute is this: the excellent companies *really are* close to their customers" (p. 156). Another finding is that success begets success. As a park fills up, it makes the remaining space seem more attractive. And a good sales point for a prospective industry is a locale's prior success at attracting other industries.

Lesson 2: Attitudes toward economic development matter greatly.

Positive attitudes help, negative ones hurt. One respondent told of a company president who decided not to move to an area because he perceived that residents had many negative feelings about their county. As he put it: "I am not going to come to a place where people don't like it." For this county, creating a more favorable environment among its own citizens will be an important step if economic development is to occur.

Often residents (including some non-Maryland ones) have more negative images of their counties than deserved. In the study, for example, many negative comments were made about one county's school system, but it turned out to be much better than some people thought. This same thing was true of the workforce. Local leaders made disparaging remarks about it but new employers generally expressed satisfaction or cited problems that were common to most areas. In general, work attitudes were good where the pay was good, and this was true even where local leaders complained about poor work attitudes.

Leaders in some counties simply fail to evaluate their assets as highly as do outsiders. An economic development program must include activities that will change the negative perceptions and attitudes of residents. Indeed, the ability to enhance feelings of self-worth and to see assets and opportunities where others see failures is an attribute of a leader.

Lesson 3: Joint action between local, state and Federal agencies is desirable.

The majority of major development endeavors had important contributions from both local and outside levels. An active local component is important, but often additional, external resources are needed to launch a project.

Lesson 4: Residents of local communities have a strong desire to preserve their way of life.

Dying counties are painful places to live for local folk who have a history and vested interest in them. Thus

job-generating efforts usually are supported, but almost always with deep ambivalence because of the fear that the traditional, local way of life will change (for the worse). In the Delmarva study, the favored approaches in dealing with similar circumstances were usually "slow growth" or "controlled growth." There were, however, many supporters of "no growth." To complicate this matter, often representatives of the latter group were newcomers (retirees, owners of vacation homes, and so on).

Conclusions

As is quite clear, Maryland communities, although adjacent to one another, may have drastically different philosophies about industrial recruitment and economic growth and development. One community's desire for growth is often matched by a neighboring community's desire for things to stay the same. Whichever direction a community pursues, certain basic questions should be answered.

1. How are rural areas kept rural? What steps can be taken to preserve a rural way of life? At what price? Should steps be taken to save rural areas?
2. If young people have to leave rural areas to find work, how can the areas remain vital from one generation to the next? Can steps be taken to remedy this?
3. If a rural development strategy was perfectly successful, would it make nearly everyone affected happy? What would this strategy look like? What results would it yield? Are Lancaster, Pennsylvania and Deep Creek, Maryland examples of successful rural development strategies?
4. Should emphasis be placed on bringing outside industry into local communities or developing policies that would encourage more local investment, a kind of "help thyself" approach?
5. Does the state have a unique role to play as an investment partner in rural areas unlike that in urban areas? Rather than "state" projects located in rural areas (such as the prison in Somerset), should there be more emphasis on the state creating risk capital funds from which local communities and individuals could borrow for local investment?
6. In an increasingly service-oriented society, can rural areas provide services at what economists call a "comparative advantage"? That is, can rural areas compete for some types of service work? (There are numerous examples of this related to the use of electronic communications since national and international contact is possible with no real advantage gained by being in an urban area.)

In closing, two simple points should be stressed: First, nothing lasts forever. So why should life in rural areas be expected to go on as it has in the past? Second, only those things considered important are saved. How important is the cultural heritage in Maryland's rural communities? How can a community develop yet retain those qualities it values most?

The research findings discussed earlier suggest that whether or not local communities wish to grow is a moot point—inevitably they will change, some will progress while others will decline. The real issue is trying to control the destiny of one's own community. To do this means making a rational choice. Residents and leaders must decide what kind of development will be necessary to create the community they would prefer to have, rather than letting things take their own course and having to settle for whatever happens.

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Agriculture in the 21st Century

Lowell B. Catlett

Many Texans still have a fond spot for the good people of Cincinnati, Ohio. They gave Texas two cannons in 1836 to help in Texas' battle for independence. It turned out that these two six-pound cannons were the only cannons that the Texas Army had. They were known as the famous "Twin Sisters". Thus in the Battle of San Jacinto the Twin Sisters were invaluable in General Sam Houston's victory. General Houston wrote to the citizens after the battle:

> Tell our friends all the news, that we have beat the enemy, killed 630, taken 570 prisoners. General Santa Anna and Cos were taken, three generals slain; vast amount of property taken and about 1500 standards of arms, many swords, and one nine-pound cannon. Tell them to come on and let the people plant corn.

Americans will find that their agriculture in the year 2001 will be similar to the Twin Sisters—there will be only two production groups that are invaluable to the success of the industry. These twin sisters of production agriculture will impose changes on the agribusiness system. Consequently, agribusiness will be polarized in the same manner as the agricultural twin sisters. The agricultural industry will be bimodal with two totally different types of market channels.

Agriculture's Twin Sisters

The twin sisters in agriculture are not identical, but fraternal. One will be large, capital intensive, high tech and driven by world markets. The other will be smaller, both capital and labor intensive, both high tech and antique, and driven by local specialty markets. Both will produce multiple products—most likely several food products, several industrial products, some pharmaceutical products, and entertainment.

The larger sister, sister A, will number approximately 200,000 production units by the year 2001. She will be characterized by mostly large acreage units, but more importantly by sophisticated technologies. Geographically sister A-type farms and ranches will be located mainly in the Midwest and west, however some will be located in parts of the south and east.

The business form of these farms will be a combination of sole proprietorships, partnerships and corporations with several being cooperatives. Most units will be involved in joint ventures and use vertical coordination with other agribusiness operations because of world markets. The production unit will not exist in isolation because of the necessity of being in world markets.

Sister A-type farms will produce several crops and manage diverse livestock enterprises. The production will consist of

- traditional crops (corn, wheat, soybeans and cotton);
- traditional livestock (cattle, swine, sheep and poultry);
- new crops (for dyes, acids and oils);
- new livestock (beef with less cholesterol);
- basic products (such as protein and energy); and
- entertainment (outdoor experiences and wildlife).

Sister B-type farms will number approximately 1 million production units by the turn of the century. The

production units will generally be small acreages comprised primarily of three types of producers:

1. gourmet producers who look at local and specialty markets and produce for restaurants, wholesalers and mail order;
2. traditional part-time producers who have off-farm jobs and live on acreages that produce traditional crops and livestock; and
3. second career producers who are retirees or others who live on acreages and start second careers in production agriculture. Many of these second careers will turn into full-time occupations.

Geographically, sister B-type farms will be concentrated around large cities across the United States and in the Eastern and Southern United States in traditional farming and ranching areas. Almost all of these farms will be sole proprietorships with very little vertical integration except through membership in cooperatives. There will be some vertical coordination, especially with the gourmet producers and the agribusinesses that buy the products.

The product mix will be similar to those of sister A-type farms and consist of

- traditional crops and livestock (mainly by the traditional part-time producers and the second career producers);
- new crops and livestock (mainly by the gourmet and second career producers);
- basic products for protein and energy (gourmet and second career producers); and
- limited entertainment (second career producers involved in bed-and-breakfast-type entertainment).

Reasons for Two Types of Agriculture

Agriculture will become polarized because of rapid advances in artificial intelligence (AI) and genetic engineering (GE). AI will cause capital labor substitution and GE will introduce new crop and livestock enterprises. The joining of AI and GE will introduce new profit opportunities in protein and energy production.

Approximately 1,000 commercial robots existed in 1979 and currently about 31,000 exist in the United States. Although very few exist in commercial applications in agricultural production, agribusinesses are moving toward the use of robots in inspection, grading, packaging and product design. Several firms are working on robotic application in production agriculture for planting, tilling, spraying and harvesting crops. Livestock robots will monitor health, location and feeding. AI systems for management will include programs for the integration of technical information about the crop or livestock enterprise, risk, pricing alternatives, world conditions and weather.

These AI systems will be capital intensive and thus will be adopted by only the sophisticated and well-financed operations. Almost all of the sister A group will be heavily roboticized by the early part of the 21st century.

GE, on the other hand, will produce crops that are resistant to diseases, chemicals and pests. Some crops will produce all or part of their own fertilizer needs. With GE new crops will be added that produce industrial products (such as acids, oils and dyes) and pharmaceuticals. Crops that have more protein, a certain color, or unusual characteristics also will be introduced. GE will produce so many crops that can produce industrial products, that the early part of the 21st century will be known as the "industrialization of agriculture". However, nature with the help of GE, will produce most industrial products.

"Microbes will be altered to produce protein, create energy, remove toxic wastes, clean up water systems, and produce pharmaceuticals."

GE in animals will improve health through vaccines and drugs that will be developed and given to the animals. But the major GE technology will be "whole animal GE"—that is, it will make the animal naturally resistant to diseases, bigger, smaller or with certain valuable characteristics. Perhaps a different color of coat or beef low in cholesterol would be a characteristic that may be valued.

GE will alter the microbes such that the 1990's will be called the "Decade of the Microbes." Microbes will be altered to produce protein, create energy, remove toxic wastes, clean up water systems, and produce pharmaceuticals. This will be accomplished in conjunction with AI. The AI systems will monitor, control and operate the GE microbe processes.

Using the GE microbe technology and AI technology will allow each production unit and some agribusinesses to transform low-value products into high-value products. With the appropriate technology, low-value biomass such as corn stalks and wheat stubble will be transformed into concentrated protein or energy or

both. Additionally, wastes from animals will be upgraded into concentrated fertilizer, protein or energy. Both A- and B-type farms will incorporate these onsite value-added technologies.

The Outcome

Numerous new agribusinesses will be created as production agriculture changes. The growth areas will mimic the areas in production agriculture and will include

- management systems using AI;
- robotic programming and servicing;
- onsite value-added systems of AI and GE;
- packaging, inspecting and grading systems;
- mail order and electronic marketing of food;
- wholesale and retail sale of new gourmet foods;
- institutional food systems; and
- input suppliers for sister B-type farms (such farms will need special chemicals, fertilizers, and equipment).

What traditionally is called agriculture will make up a small portion of the food and fiber system in the 21st century. Traditional farmers, ranchers, loan officers and suppliers will be the minority. Even the food, for the most part, will be different in texture, packaging and taste. The 21st century will be the beginning of the end of what is traditionally thought of as agriculture. Replacements will include robotic cowboys and tumbleweeds that produce the United States' energy supply. So what will the new model of production be called? Is it agriculture? Or is it energy? Mechanics? Biotechnology?

One thing is for sure—whatever its new name, it will be bigger, more sophisticated and full of new opportunities for the bold, brave and daring. To paraphrase General Houston: Tell them to come on and let the people plant corn—corn for energy, corn for dyes and corn for heart medicine.

Conference Participants

Norman A. Berg, M.A., senior advisor to the American Farmland Trust, is dedicated to helping protect agricultural land and promote farming, ranching and forestry. He is a former chief of the Soil Conservation Service and now a member of the governing board for the Anne Arundel Soil Conservation District. He has been a faculty member of the USDA Graduate School for 25 years, and is treasurer for the Natural Resources Council of America. Berg is a charter member and fellow of the Soil and Water Conservation Society. Awards: USDA Distinguished Service Award (1973); National Wildlife Federation Conservation Award (1980); Presidential Rank Award (Meritorious Executive) (1980); National Award for Agricultural Excellence (1984).

Herbert L. Brodie, M.S., Extension's principal specialist in agricultural engineering, also is a professor in the Department of Agricultural Engineering at UMCP. He helps farmers and county, state, and Federal agencies improve land and water resource management. Also a registered professional engineer, Brodie has for the past 24 years developed education and engineering assistance programs in waste and water management and authored technical papers and Extension publications about animal waste, nutrient management, cropland irrigation, municipal sludge disposal and residential sewage treatment. Other topics include methane generation for farm energy and swine housing systems.

Lowell B. Catlett, Ph.D., is a professor in the Agricultural Economics and Business Department at New Mexico State University. He also is a consultant and advisor for the U.S. Department of Agriculture, Department of the Interior, U.S. Army and other organizations. Catlett teaches and conducts research in marketing, policy, futures markets, management and futuristic issues. He coauthored a textbook and two forthcoming textbooks, and has authored numerous reports, articles, and papers. Awards: Teacher of the Year at New Mexico State University, Don C. Roush Award for Excellence in Teaching, and the Burlington Northern Foundation Faculty Achievement Award for Outstanding University Teaching.

Roland E. English III, M.S., director of the Office of Comprehensive State Planning, has worked for the Department of State Planning since 1974. He also is a land design consultant and member of the American Institute of Certified Planners. English has experience in planning and zoning on the county and municipal levels as well. He received master's degrees from Clemson and Johns Hopkins Universities (having studied architecture, urban geography, city and regional planning and political science). He has authored plans and publications related to land development, growth management, and resource protection. He has been a Maryland Government Executive Fellow and received the Built Environment Award from the Maryland Chapter of The American Planning Association.

William W. Falk, Ph.D., is a professor and chair of the Department of Sociology at UMCP. His recent book (written with Thomas A. Lyson), "High Tech, Low Tech, No Tech: Recent Industrial and Occupational Change in the South," expresses one of his primary concerns—changes in that area's "fabric of life." Falk spent 2 years as an urban planner in Dallas, Texas, before spending 11 years as a professor of sociology at Louisiana State University, and 3 years as editor of the *Rural Sociology* journal.

Kurt Finsterbusch, Ph.D., a leader in the field of social impact assessment, is an associate professor in the Department of Sociology at UMCP. He examines the effects of projects, programs and policies on people, groups, organizations and communities. Finsterbusch is especially interested in the development of Third World countries and economic development activities in rural America. His current project involves studying the economic development of the Delmarva Peninsula and Southern Maryland. He coauthored Understanding Social Impacts and Organizational Change as a Development Strategy.

Bruce Gardner, Ph.D., is a professor in the Department of Agricultural and Resource Economics at UMCP. His research interests include the causes and consequences of economic well-being in agriculture (particularly skills and labor markets), international trade and marketing, and agricultural policies. Before coming to Maryland, Gardner received his doctorate from the University of Chicago and held faculty positions at North Carolina State and Texas A & M University. He also served as senior staff economist for agriculture at the President's Council of Economic Advisers (1975–1977). He is author of Optimal Stockpiling of Grain, The Governing of Agriculture, and The Economics of Agricultural Policies.

Darrell Hueth, Ph.D., became a professor and chair in the Agricultural and Resource Economics Department at UMCP in 1984. His primary research interests are natural resources and applied welfare economics. Hueth has held faculty positions at the University of Rhode Island, the University of California-Berkeley, and Oregon State University. A former editor of the *Western Journal of Agricultural Economics*, he also is a past member of the board of directors of the American Association of Environmental and Resource Economists. He wrote "Optimal Agricultural Pest Management with Increasing Pest Resistance," and "Policy Implications of Agricultural Biotechnology."

John K. Hutchison, Ph.D., has been project director of The University of Maryland Science and Technology Center for Carley Capital Group since 1985. He has prepared traffic studies, water quality impact assessments, historic sites and preparation of zoning texts. Before coming to Maryland, Hutchison was assistant professor of physical planning and land development at the School of Architecture, University of Virginia. He taught site analysis and planning, fiscal impact analysis, land use regulation and citizen involvement. Hutchison also provided land use planning and economic development support to Wisconsin communities through the university Extension Service, while program director of the Wisconsin Critical Areas Program.

Shain-dow Kung, Ph.D., professor of plant molecular biology, also is the director of the Center for Agricultural Biotechnology, UMCP. His current work involves studying the molecular biology of genetic tumors in plants. Recently, he was selected as a member on the Agricultural Biotechnology Research Advisory Committee for the U.S. Department of Agriculture. Other achievements include: Fulbright Scholar, Award for Distinguished Achievement in Tobacco Science for his extensive work on tobacco, and writing nearly 80 scientific articles, and editing two books in biotechnology. He is the editor-in-chief for a yearbook series on genetic engineering in agriculture.

Douglas Lipton, M.A., is a marine economic specialist in the Department of Agricultural and Resource Economics at UMCP. After receiving his Master's he worked as a fishery biologist and later as a fishery economist for the National Marine Fisheries Service in Washington, D.C. Lipton, who is completing his doctorate, has authored and coauthored numerous publications including "The Status and Health of the Maryland Seafood Industry," and "Disease Organisms, Economics and the Management of Fisheries" (with Ivar Strand). Awards: New York State Regent Scholarship Award, and a National Sea Grant Fellowship Award.

William L. Magette, Ph.D., is an assistant professor and Extension agricultural engineer in the Agricultural Engineering Department at UMCP. His programs address the effects of agricultural practices on water quality, and he is investigating methods of controlling nonpoint source pollution. President of the Maryland Old Line Chapter of the Soil and Water Conservation Society, Magette also is a member of five professional societies including the American Society of Agricultural Engineers and the National Society of Professional Engineers. Awards: He has received four national awards from the American Society of Agricultural Engineers for his educational materials addressing environmental issues.

Raymond J. Miller, Ph.D., is vice chancellor for agricultural affairs for The University of Maryland System and dean of the Colleges of Agriculture and Life Sciences at UMCP. He is responsible for all agricultural programs at the university, which includes instruction of agricultural programs, Maryland Agricultural Experiment Station and Cooperative Extension Service. Miller joined the university in 1986, having come from the University of Idaho where he was dean of the College of Agriculture.

Robert W. Sheesley, M.S., is director of the Department of Environmental Protection and Resource Management. His responsibilities cover the entire range of environmental concerns and the management of natural resources in Baltimore county. Sheesley received two master's degrees from Johns Hopkins University (one from the School of Hygiene and Public Health, and another in administration). Sheesley has 19 years of experience in all areas of environmental management. One of the programs that he oversees in his department is the Agricultural Preservation Program. Sheesley also oversees all issues related to the management of agriculture as a resource in Baltimore county.

Bernard F. Stanton, Ph.D., is professor of agricultural economics in the New York State College of Agriculture and Life Sciences, Cornell University. He teaches courses in farm and food policy and research methods,

and is involved with Extension programs in food and agricultural policy, outlook, and farm management. Stanton is a member of the American Agricultural Economics Association and International Association of Agricultural Economists. He received his doctorate from the University of Minnesota (1954) and held the Elmhirst Scholarship at Oxford University from 1950–1951. Stanton's international experiences include being a Fulbright research scholar at the University of Helsinki Finland; visiting professor, Department of Agricultural Economics at Tamil Nadu Agricultural University, Coimbatore, India; and a research scholar at the Commission of the Economic Commission in Brussels, Belgium.

Ivar Strand, Ph.D., a professor in the Department of Agricultural and Resource Economics, UMCP, is primarily interested in natural resource economics and applied econometrics. He is on the university's Aquaculture Task Force and the Scientific Advisory Board for Maryland's Power Plant Research Program. Strand is an associate editor of *Water Resources Research* and *Transactions of the American Fisheries Society*. His most recent article, coauthored with K. E. McConnell, is entitled "Measuring Water Quality Benefits to Commercial Fisheries When Both Demand and Supply Depend on Water Quality". He has served on the Fisheries Task Force of the Ocean Policy Committee, National Academy of Sciences, and the Scientific and Statistical Committee of the Mid-Atlantic Fisheries Management Council.

Joseph F. Tassone, M.S., Maryland Department of the Environment. He evaluates water quality and the effectiveness of efforts to control nonpoint pollution sources. He received his education and training at The University of Maryland and the Virginia Polytechnic Institute. At Virginia Tech he researched the effects of commercial timber and multiple use management on forest ecology. His work as a research biologist has included investigations on the effectiveness of storm water management methods for the U.S. Fish and Wildlife Service, and the effects of highways on wildlife for the Federal Highway Administration. He also is the recipient of the Technical Studies Award from the American Planning Association, 1988.

Richard A. Weismiller, Ph.D., associate professor in the Department of Agronomy, UMCP, also is an Extension specialist on soil and water resource management. He develops and presents information and educational materials on agricultural soil management, soil and water conservation, groundwater, soil survey interpretation, waste disposal and nonpoint source pollution control and abatement. Weismiller is studying nonpoint source pollution from agricultural systems and remote sensing of soil resources and teaches courses on soil and water pollution and land use. He is a member of the Soil Science Society of America, American Society of Agronomy, Soil and Water Conservation Society, and International Soil Science Society.

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